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Standardization
Design to Cost

April 1973

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IN THIS ISSUE

Contributing artists for this issue are: Mary L. Field and Orville O. Tonoda.

Comment

by William P. Clements Jr.
Deputy Secretary of Defense

The primary responsibility of the U.S. Government is to provide security and freedom for the American people. We in the Department of Defense have the principal role of assuring this security and freedom against any external threat. We cannot succeed in this role if our Nation becomes a second rate power. Such a status would threaten President Nixon's initiatives for world peace and directly threaten our Nation and its people.

I am confident the American people and their representatives will provide the Department of Defense with the understanding and resources necessary to meet these responsibilities. It is our job in the Department of Defense to conduct ourselves and our affairs in a manner which earns public confidence and which demonstrates responsible and efficient use of the resources provided.

Certainly one of the greatest challenges that faces us in earning and maintaining public confidence and understanding is a demonstration of efficiency in weapon systems procurement. I recognize the great improvements that were achieved the past four years, and I have personally observed the problems that were generated by inefficient and unwise policies of earlier years.

One of my principal objectives as Deputy Secretary of Defense is to further improve our procurement process so it deserves and earns the support of the American people. During my brief period in office it has become apparent to me our basic policies are largely satisfactory, but greater attention must be given throughout the Department to their application and implementation.

In the months immediately ahead, I will give priority to increasing my knowledge of the Defense Department and its procurement process, with particular emphasis on meeting and working with those people who are charged with actually getting the job done.

I accepted this position as both a challenge and an opportunity. I look forward to working with Secretary of Defense Elliot Richardson and with you in our common efforts to assure the Nation's security as we move toward the President's goal of lasting world peace.

Facts of Life Require Rejuvenated Standardization Efforts

Is the DOD Standardization Program so organized and managed that the design aspect of standardization is properly accented on both the policy and drawing board levels? To answer this question adequately it would be necessary to examine the Standardization Program in all of its countless facets.

Such an examination would undoubtedly show there is extensive involvement of design activities of the Military Departments and Defense Agencies in standard setting functions. The Defense Cataloging and Standardization Act of 1952 which established this program links standardization primarily, if not exclusively, with supply. This is quite understandable in light of supply problems during World War II when each of the Military Departments procured hundreds of thousands of common items of supply in different sizes, shapes, colors, textures, etc. Understandably this proliferation complicated supply and maintenance operations. The Standardization Act was intended to preclude this situation in the future.

Design—Its Critical Role

The problem of standardizing more common items has now been reasonably well resolved. The central problem today is to control the entry of similar but different parts, components, subassemblies and assemblies into major weapon systems. There is hardly any question that this problem can best be resolved during the design and development of weapon systems.

by Hugh McCullough
Acting Assistant Secretary of Defense (Installations & Logistics)

"In supply standardization, it shall be the duty of the Agency to achieve the highest practicable degree possible in the standardization of items used throughout the Departments of Defense, through the development and use of single specifications, in the elimination of overlapping and duplicating item specifications, and in the reduction of the number of sizes, kinds, or types of generally similar items. The greatest practicable degree of standardization of methods of packing, packaging, and preservation of such items shall be achieved, together with the most efficient use of services and facilities concerned with the inspection, testing and acceptance of such items."—Defense Cataloging and Standardization Act of 1952.

Organizing for Standardization

The 1970 Report of the House Committee on Government Operations, entitled "Military Supply Systems . . . Cataloging, Standardization and Provisioning of Spare Parts," makes this point very cogently, *viz*:

". . . The most effective way of saving money

in supply operations such as cataloging, provisioning, procurement, storage, and item management is to control the number of parts designed into military end items. . . . The concept of standardization in design is not new. Large manufacturing concerns face, in smaller degree, the problem of restricting the number of items used in their operations. The commercial manufacturer who must supply repair parts is careful to keep new parts to a minimum. He does this by using components from previous equipments in his new designs, keeping the same trunklid latch for several years, and the like. Design restraint is a necessity, for the engineer by training and inclination seeks the new and different. Efficient business management calls for new parts only where they really make a significant difference and are worth the added costs. . . ."

Regardless of what words or phrases are used to describe the "standardization problem" the nub of the matter relates to design.

Nonetheless the fact remains the Standardization Program has been largely managed and oriented as a supply function.

One conclusion is inescapable. If the program is to realize its fullest potential, particularly with respect to supporting current DOD efforts to reduce the weapon acquisition cost, the Standardization Program must acquire stronger design inputs and orientation. Happily this fact is well recognized. On Oct. 5, 1972, Dr. John S. Foster Jr., Director of Defense Research and Engineering, speaking on the subject of increasing defense electronic productivity, minced no words when he said:

". . . standardization is not a dirty word. We realize there are significant barriers to its implementation, so we must organize for it, and we must insist upon it. It must become institutional in order to be effective, not a one-shot or a one-Service experiment. Implementation will be difficult, but the potential rewards of standardization, properly applied, demand greater efforts. . . ."

Dr. Foster got down to specifics in his talk when he said:

". . . Let me indicate one example of our failure in an area that could benefit greatly from standardization—tactical UHF radios. These radios perform the same functions in four environments—shipboard, vehicular,

ground, and aircraft. We have developed different equipment for each of these environments. What's worse, within each environment we have developed different types. Even within the same platform type we have different models of the UHF radios. There are at least ten different airborne UHF transceivers of the same vintage employed in our forces today, all performing the same function. . . ."

Whatever is said about UHF radios might be said about thousands of other parts, components, subassemblies and assemblies procured and maintained by the Department of Defense.

DOD Standards and Specifications Board

It is not enough, however, to merely preach "design standardization." Action is needed. But this action must be instituted in a way that retains those features that over the years have made possible such immense standardization progress to the benefit of the Nation as a whole. After all, the DOD Standardization Program is the most significant one of its kind in the United States and possibly the world. However, the fact remains the program needs rejuvenation to make it compatible with the economic and technological facts of life in 1973.

To get to the heart of the matter it seems quite evident the future progress of the program depends on:

- Stronger infusion of design discipline on both the policy and procedural levels.
- Integrated guidance by persons who represent both design and logistic interests of the Office of the Secretary of Defense, Military Departments and Defense Agencies.

I, therefore, recommend that a DOD Standards and Specifications Board be established to provide integrated guidance to this program. Membership would represent design and logistics elements of the Office of the Secretary of Defense, Military Departments and Defense

Agencies. Such a Board would appropriately have authority to establish policy, assign responsibilities and projects, assess progress and make hard decisions regarding specifications and standardization when such decisions become necessary.

The central deficiency of the DOD Standardization Program is its excessive supply and logistic identification. The proposed Board would have the therapeutic effect of broadening program perspective and strengthening leadership by involvement of a full range of design/development and logistic disciplines. It would be naive, however, to suggest that the establishment of one more DOD board or committee will solve a chronic problem. Nonetheless the character of this problem—interdisciplinary and inter-Service—necessitates integrative committee-type action. The effectiveness of the Board obviously will depend on the vision and initiative of its members and the support of their parent departments and agencies.

Other Improvement Actions

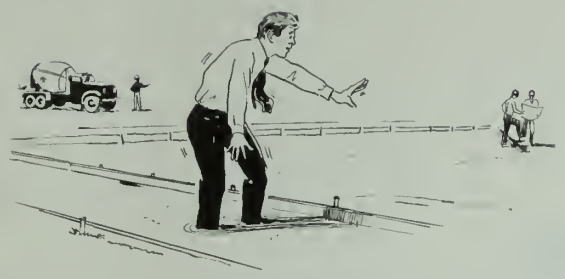
What further actions are needed to improve the quality and timeliness of DOD specifications and standards? The first answer to the question relates to people. There is need to recognize the unglamorous but critical role that standards engineers play in the affairs of the Department of Defense. This probably could best be accomplished by establishing a career incentive, with prospects for future advancement in this area, as has already been provided for in procurement and quality assurance. It would be advantageous for DOD to disengage from all standards and specifications functions not directly related to military procurement, production, supply and maintenance. Why, for example, should DOD issue a specification for a baby's diaper? The time has come to explore

the proper roles of the various U.S. Government agencies and departments in standards setting so that other departments assume responsibility for standards and specifications that apply both to the military and civilian economy.

The moment is long overdue for DOD to make better use of the resources of private standard setting organizations. Granted there are problems of defining the proper roles of Government and private organizations in drafting, publishing and updating standards. These problems, however, can be surmounted.

There is need for serious research to develop improved techniques for drafting standards and specifications and other documents, including RFPs, that attempt to delineate everything

from nuts and bolts to space ships. It is interesting to observe that despite the powerful impact of standards—for good or evil—on the costs of defense, very little attention has been paid over the years to the theory and technique for writing specifications. No wonder standards setting is an underdeveloped technology. Frequently, therefore, specifications represent the capricious viewpoints and inclinations of specification writers rather than application of objective and rational criteria for what should or should not be included in specifications. A knowledgeable observer of the engineering design scene once said that ". . . engineering design is much like concrete. Once mixed, it sets up rapidly and becomes highly resistant to change." The same might be said of specifications and standards. A good specification has great potential for doing good; a bad specification has equal potential for doing evil. Once a



specification is written it is not readily changed. Its provisions go on and on—sometimes generating testing, paperwork and other requirements that serve no useful purpose.

Lastly, there is need for stronger legal initiatives in enforcing specifications. Either a specification means what it says or it should be excised from the specification system. If it *does* mean what it says, its provisions should be vigorously enforced. Unfortunately, such enforcement is often not practical because the specification is deficient as an engineering document.

The Larger Environment

The subject of standards and specifications should also be considered from a general industrial and government view rather than from the more limited Department of Defense vantage point. In such a perspective it is quite evident that standards and specifications are taking on new importance because of certain major developments related to the economy as a whole. The first of these is the emergence of consumerism and recognition that specifications have a significant impact on product performance and cost. The ordinary consumer does not come in contact with industrial or military specifications. But the provisions of these specifications decisively affect the quality, reliability, safety and performance of practically all the services and hardware we depend upon for everyday living.

One pound = .45 kilogram
One kilogram = 2.2 pounds

Many people believe this country will not long remain a nonmetric island unto itself by using the inch/pound system rather than the metric system. The Defense Department must be alert to developments in this area.

Computerization has a potent impact on standards and standardization. The rapid application of numerical control and computerized design techniques necessitates a rethinking of both the form and content of specifications and standards.

Finally, it would be myopic to ignore the economic impact of specifications on trade, foreign and domestic. For many years the specifications developed, upgraded and issued by DOD have played a highly significant role in industry. DOD specifications for electronic components are the *lingua franca* of both the domestic and international electronic component industry.

In summary, then, it seems quite evident developments outside DOD suggest clearly the standards and specifications setting activities of both DOD and the U.S. Government must be strengthened in the national interest.

A Final Note

Probably the most perplexing and frustrating aspect of standardization management is assessing its usefulness in economic terms. It is easy enough to pinpoint what standards, specifications and related activities cost. But how does one measure economic benefits? In the past this question has not been adequately answered. This is not to suggest that there are not real benefits. Not all benefits can be measured. Nonetheless, proof is needed.

Cost comparisons should be made between major weapon systems programs that include strong parts control and standardization disciplines and those that do not. Such comparative cost analyses undoubtedly will be accomplished more frequently in the future as DOD and defense contractors react to new pressure for more vigorous cost control. In a word, then, the future of the DOD Standardization Program is largely contingent on its provable capability to reduce design, development, procurement, production and supply and maintenance costs. □

DSA Applies Hammer to Standardization

The Department of Defense has only scratched the surface in realizing the potential benefits that can result from an effective standardization program. The potential payoffs are unlimited in terms of improving military materiel readiness, the effectiveness of logistics management, and reducing acquisition and operating costs.

The complexity and relative ineffectiveness of the present DOD Standardization Program have been widely acknowledged by Congress and industry. The Military Services and the Defense Supply Agency (DSA) have been unable to agree on many needed projects to update specifications and standards, and reduce the variety of items in the DOD inventory. In addition, we are still trying to develop a DOD system to improve standardization at the design stage where the potential benefits are the greatest.

Lack of resources is often used as a reason for not accomplishing needed standardization projects. The long range benefits are overlooked in our efforts to satisfy the immediate supply requirements of the Military Services, but we must insist on increasing the effectiveness of our standardization efforts.

Unnecessary variety of items and outdated specifications and standards continue to adversely affect procurement and supply management. These problems became more acute during the Vietnam buildup as priorities shifted to the support of our forces in Southeast Asia.

Now is the time to place renewed emphasis on improving standardization management at all levels of Government and industry. This effort must receive the highest levels of attention and top priority with regard to resources for specifications and standards improvements. We must reevaluate the allocation of DOD logistics resources.

by Lt. Gen. Wallace H. Robinson Jr., USMC
Director
Defense Supply Agency

Standardization with Less Resources

The budget dollar is getting tighter and further reductions in manpower are expected. The R&D community is adopting a design to a cost philosophy, and the Military Services and DSA must develop specifications and standards that contribute to this objective. How can we now accomplish more in standardization with less resources? This can only be done through better management, in particular better planning and programming, and the development of improved systems to accomplish planned objectives.

The basic objective of the DSA Standardization Program is to improve the operational readiness of the Military Services by increasing the efficiency of logistics support. Reducing the types, sizes and kinds of items in the DOD inventory and maintaining state-of-the-art

specifications and standards will contribute in a major way to achieving this objective.

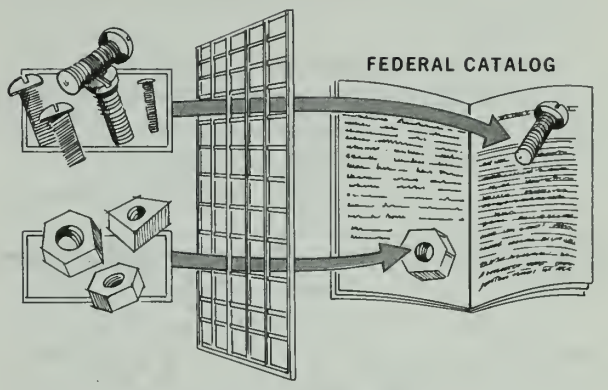
Interchangeability, substitutability, reliability and maintainability will be greatly enhanced and reductions in inventory made possible. Supply support will be improved and, at the same time, the Military Services and DSA will conserve money, manpower and facilities.

DSA will alert decision makers of the Military Services on those standardization problems upon which agreement cannot be reached. We will question specifications where overlap and duplication have eroded the supply system, and where outdated specifications result in the waste of procurement dollars.

DSA supply center commanders are personally involved in working with the Military Service commanders on problems of mutual concern. DSA cannot provide the Military Services every item they want all the time—we must offer substitutes in noncritical applications. This same philosophy must be applied to the development of specifications and standards.

DSA is also developing new techniques to communicate the availability of standard parts to the design community. Design selection documents affect design and development and must also be maintained to reflect the state of the art.

The selection of standard parts will eliminate the cost of processing a new item for the Federal Supply Catalog. Item identification and drawings will not be needed. Reliability will be ensured and logistics support greatly simplified. Design standardization, while the most difficult to achieve, has the greatest potential for reducing the cost of logistics support.



DSA Standardization Management

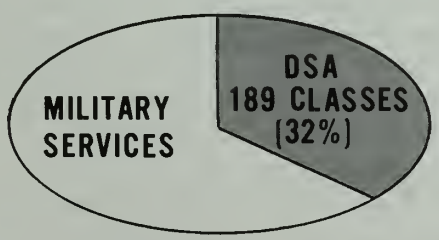
The Defense Supply Agency is the DOD Standardization Assignee Activity for 189 Federal Supply Classes, comprising approximately 50 percent of the items in the DOD inventory. An assignee activity is the standardization manager and the principal point of contact in a Military Department or Defense Agency, and supports the Office of the Secretary of Defense in developing policies and programs. The commander of the assignee activity has the authority to act for the Secretary of Defense to make decisions on all aspects of standardization program planning, scheduling and management upon which agreement cannot be reached with or among the Military Services.

The Defense Supply Agency took a deep look at its standardization program in 1972, and implemented a revised management program designed to accomplish the following objectives:

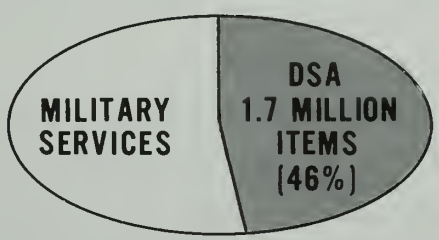
• Identify significant problems in each assigned Federal Supply Class and identify

DOD STANDARDIZATION MANAGEMENT RESPONSIBILITY

(As of 31 December 1972)



TOTAL: 592 FSC CLASSES



TOTAL: 3.67 MILLION ITEMS

impact (in dollars if possible) on procurement and supply management.

- Obtain agreements with the Military Services on high priority projects involving the revision of specifications and standards and elimination of unnecessary items.
- Escalate significant areas of disagreement to OSD for final decision.
- Eliminate unnecessary projects of low priority.
- Coordinate programs with appropriate industry associations.
- Develop new techniques to communicate available standard parts to industry.
- Ensure involvement at every level of decision making and improve our management capabilities.
- Reduce unnecessary paperwork and coordination by concentrating on high priority work.

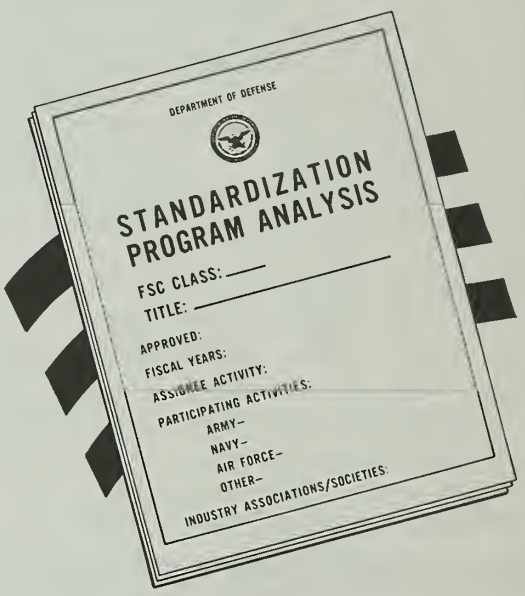
Generally, the Military Services have responsibility for projects to develop specifications and standards. It is DSA's job to ensure the Military Services are apprised of problems affecting supply management and procurement. Our plans and programs must highlight the specifications and standards that require change and provide an agreed upon schedule for accomplishing these changes.

DSA is dependent on the resources of the Military Services for much of its standardization effort. We must convince the Military Services of the importance of accomplishing required standardization projects, for they impact significantly on DSA's only reason for existence: to provide increased efficiency in logistics management by eliminating overlap and duplication and to provide responsive support to our country's military forces around the world. In this period of reduced manpower and money, these considerations become even more important.

Involvement Is the Key

The DSA revised Standardization Management Program is based on involvement by decision makers at all levels. We are reorienting our planning and programming in each Federal Supply Class to emphasize significant problems or opportunities which relate to the functions of design and development, procurement and production, inspection, supply and maintenance, and disposal. Our middle and top management personnel must become involved in working with their counterparts in the Military Services and appropriate industry associations to resolve these problems.

We must question the standardization projects that are currently being planned and scheduled by DSA and the Military Services. Are we working on the high priority areas—the ones with the greatest return in terms of cost or benefit relationships? Our current plans often do not relate problem areas to impact on supply management and procurement, nor do they relate outdated specifications and standards to acquisition costs and operating costs. We must put aside vested interests and parochial views and think of standardization in terms of its effect on the Nation's security posture, and not on any one Military Service or Defense Agency.



DSA supply center commanders have been directed to pursue this course, and DSA is currently developing FY 1974 plans and programs with this approach in mind. Certainly, we face many obstacles and our program is dependent on complete teamwork among DSA, the Military Services and industry.

DOD Five Year Standardization Program

The DOD Five Year Standardization Program requires annual plans for the management of each Federal Supply Class. DSA has revised this important management tool to

reflect significant problems in each class, with emphasis on resolving as many as possible at the DOD Standardization Assignee Activity (supply center) level. Decentralizing this effort will facilitate top management's ability to escalate the remaining significant unresolved problems—all the way to the Secretary of Defense, if necessary.

This planning process is the vehicle for managing a complex system and must reflect agreements reached to accomplish standardization projects rather than documenting a list of things that someone should do. A time phased program is agreed upon by the assignee activity and the participating activities of the Military Services.

DSA is emphasizing elimination of unnecessary paperwork and projects, and reduction of coordination time for technical review by the Military Services. We have revised our program and made it "problem oriented." We are using every means of communication available, including letters, briefings, meetings and seminars to bring together DSA engineering, procurement and supply people with those of the Military Services and industry. Agreements will be reached on a time phased schedule of projects to solve significant problems; the remaining backlog will be related to impact on supply management and procurement.

Then, and only then, will we have the basis for properly allocating our resources and developing priorities. In addition, we will have the information needed to escalate any significant problems on which we are unable to reach agreement.

Industry Participation

DSA is taking major strides to improve communications with industry to assist in identifying mutual problems in each Federal Supply Class, and to coordinate the work being accomplished in Government and industry.

DSA supply centers are addressing the following requirements in their first year standardization plans and programs for each assigned supply class:

- Identifying industry associations or societies interested in coordinating standardization programs for each center.
- Discussing relationships between work performed by the associations and work performed by DOD.
- Identifying specific projects being accomplished by industry which satisfy DOD requirements and do not duplicate work.
- Developing new projects for accomplishment by industry in areas impacted by limited resources.
- Reflecting coordination efforts to provide for an integrated DOD and Industry Standardization Program.

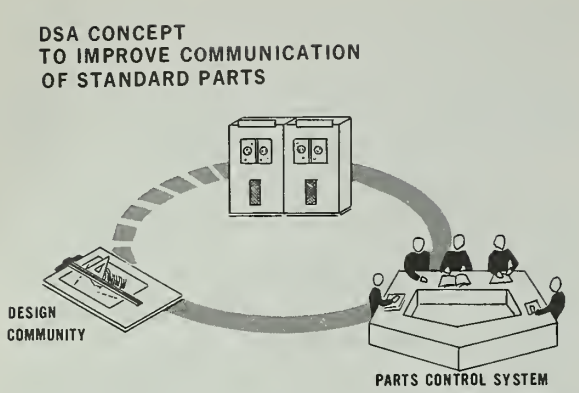
Industry can assist us in increasing productivity and holding down the cost of new weapon systems. The large defense contractors are "users" in the same sense as DOD, for they depend on thousands of vendors to produce parts for our weapon systems. They face the same resource problems that we in Government face, and they have been seeking ways to improve communication of available standard parts to the design community.

Improved relationships with industry groups will take initiative and imagination on the part of DOD program managers. If they don't come to us, we will go to them. As an example, the Aerospace Industries Association (AIA) is working very closely with some of the DSA supply centers, and agreements have been reached for coordinating our programs with AIA. We are establishing a similar relationship with other industry associations.

Standardization System of the Future

DSA is also involved in pilot testing a standardization system for the future. It is well known that the greatest potential for standardization is during the design phase, the underlying assumption being that once the design has hardened very little can be done to encourage the use of standard parts.

Since design selection of standard parts significantly influences acquisition and operating costs of weapon systems, the design community must be made aware of standard parts available for design selection. Several large corporations have developed computerized data retrieval systems which provide technical information to design engineers. With approximately 4.3 million active items in the catalog, the design standardization systems of the future must make use of today's computers. The Office of the Secretary of Defense has



assigned DSA the task of developing a computerized design selection system to fill this need.

The design selection system will utilize the Defense Integrated Data System (DIDS) and the Parts Control System (PCS) currently being developed in DSA.

Defense Integrated Data System

DIDS will provide a central data bank and retrieval system which includes item characteristics information for the design community. The operation of the system is envisioned to allow design selection personnel (whether in industry or Government) to interrogate the DIDS data bank by either part number or item characteristics to determine if there is an item in the system which meets their requirements. The DIDS data bank will provide a tailored listing of items in response to the interrogator's input. The interrogator can then select an item from the output list if it meets his needs.

Another feature of DIDS will be its capability to store part numbers which have not yet been assigned Federal Stock Numbers, thereby permitting the retention of military standard part numbers for items for which no requirements have yet been generated and no stock number assigned.

Further, nonstandard part numbers can be cross-referenced and standard stock numbered items can be stored in the data bank as the result of a nonstandard part review. A further interrogation of the same nonstandard part number would then be automatically cross-referenced to the standard item and this result provided the interrogator.

An engineering drawing file cross-referencing the part numbers will be available. Information provided by DIDS will be drawing availability, priority status and the responsible agency from which the drawing can be obtained.

Other information available will include user and supplier information and the unit price of the item. This last feature should be valuable to engineers in designing to a cost.

The long range concept is to provide a system for the contractor to directly interrogate DIDS through remote devices in the contractor's plant. When this stage is reached, standardization engineers would be used to provide expedited military standard and specification coverage, based on their review of nonstandard items selected for new weapon systems. By this updating process, the DIDS data base reflecting current technology would be maintained.

DOD Parts Control System

The DOD-wide Parts Control System is currently being used with selected major weapon system contractors to maximize the use of a human interface between the contractor and the central data bank. In addition, the system will encourage the use of standard parts in new equipment or weapon systems and maintain a technologically current data base of specifications and standards. We are working with design activities in industry to build their requirements into this system.

Total Effort Needed

Higher level attention must be given to the DOD Standardization Program for we can no longer afford the unnecessary variety of items in the inventory, and the effects of outdated specifications and standards on procurement and supply management.

Interchangeability, substitutability, reliability and maintainability problems continue to plague our logistics system. We can improve our supply and maintenance efforts and, at the same time, conserve money, manpower and facilities.

Standardization at the design stage must be improved through communication of available standard parts to design engineers. Computerized data retrieval systems must be fully tested for application in item entry con-

trol. Greater use of standard items at this stage would reduce the requirement for screening out duplicate and unnecessary items at later stages of provisioning and cataloging.

Many of the problems facing the DOD Standardization Program can be solved through a synergistic Government and industry effort. We have mutual objectives in many areas, and we face similar problems with regard to resources. Involvement and increased productivity are the keys to our success in standardization.

We have implemented a revised program designed to bring DSA engineering, procurement and supply people together with appropriate industry associations and the Military Services. Our problem oriented program is based on consensus and agreements among all parties concerned. However, we will not hesitate to escalate those problems which waste manpower and money and degrade our capability to support the Military Services.

Objective Is Better Support

The DSA Standardization Program is designed to provide better support to the Military Services which is our primary objective. Our program will:

- Improve operational readiness.
- Conserve resources.
- Reduce the DOD inventory.

DSA supply centers will alert the Military Services to significant problems affecting DSA supply management and procurement. Leadership must come from the top and everyone must become involved if we are to improve our specifications and standards and reduce the variety of items in the DOD inventory. This effort will significantly help make the design to a cost philosophy a reality and improve logistical support.

The DSA approach in solving some of the problems can contribute to solving the total DOD standardization problem. While the DSA approach has been well received so far, it will not resolve the overall DOD organizational problem related to top management attention in dealing with the standardization effort.

The Department of Defense is faced with a challenge and an opportunity to achieve unlimited payoffs in terms of improved readiness, increased effectiveness of logistics management, and reduction in acquisition and operating costs. Now is the time to put some teeth into a program that has been given only lip service for so long. □

Considerable interest in the Department of Defense Design to Cost and revitalized Standardization programs, and limited space in this issue, has required several articles on those subjects to be held over for publication in the July issue of the Defense Management Journal.

The Saga of Mobile Electric Power

The buildup of U.S. troop strength in Vietnam in 1965 caused a major electric power shortage that seriously affected the operational capability of the deployed units. The bulk of electric power used by troop units in the field is furnished by mobile engine generators. Need for mobile generators was accentuated in Vietnam by almost total lack of available commercial power.

By and large the mobile generators deployed with the troops were commercial or quasi-commercial models that had been procured to performance specifications mainly to meet general utility usage or furnished as part of a weapon system. By the very nature of this type of procurement, small quantities of unique or peculiar generators constituted the bulk of the inventory.

by Col. J. J. Rochefort Jr., USA
DOD Project Manager
Mobile Electric Power

By the end of 1965, the shortage of reliable electric power had become so serious the Department of Defense directed a study of engine generator problems, as evidenced in Southeast Asia, be conducted to avoid recurrence of similar problems in the future.

The study was undertaken by an ad hoc working group representing all DOD components (Military Services and Defense Agencies) as well as industry. The group confirmed the reasons for the problem in Vietnam by identifying over 2,000 different makes and models of generators in the DOD inventory and noted an overall shortage of requisite sets to meet current military requirements.

In Vietnam alone the study group identified 74 different makes and models of generators located throughout the country making responsive logistic support of repair parts a most difficult, if not impossible, task. The study group further noted that there was no existing DOD management system with full authority over all functional aspects of engine generators. Each Military Service, acting separately, was attempting to solve its own problems with varying degrees of success. The completed study with recommendations was approved by DOD in February 1967.

Remedial Actions

Following approval of the study recommendations, three major actions were taken.

First, the Department of the Army was designated as the Standardization Assignee for Federal Supply Class 6115, Engine Generators.

Second, the Secretary of the Army was designated DOD Executive Agent and directed to appoint a DOD Project Manager for Mobile Electric Power with the necessary authority for life-to-death management of mobile electric power.

Third, DOD Directive 4120.11, Mobile Electric Power, was published which established the policy that all Military Services utilize to the maximum extent practicable members of the DOD Standard Engine Generator Family. It further directed that no procurement of other than a standard family member be made without specific approval by the DOD Project Manager for Mobile Electric Power. The standard family was designated by power rating, divided further into tactical and prime classes, and further divided into utility and precise modes. Figure 1 shows this standard family as originally designated in mid-1967.

Project Manager Mission

On July 1, 1967, the DOD Project Manager for Mobile Electric Power was activated with the overall mission of managing and standardizing mobile electric power for DOD.

The first priority task assigned under this mission was to develop fully coordinated standardization documents and procurement data packages to procure the designated DOD Standard Family. The basic operating tools to perform this mission, contained within the DOD Standardization Program, were and are implemented by selective procurement practices and coordinated in complementing research and development effort.

Three immediate actions were necessary:

- Existing supply documentation had to be purified so that disposal of obsolete, obsolescent, or one-of-a-kind generators could be accomplished.
- Continuing proliferation through procurement had to be halted.
- Necessary standardization documents and procurement data packages had to be prepared so the designated DOD Standard Family could be fielded at the earliest practicable date.

All three actions were undertaken simultaneously.

Purification of supply catalogs and bulletins was undertaken through an item reduction study under the Standardization Program. This study was completed during 1969 and resulted in a reduction from over 2,000 separate line

FIRST DOD STANDARD FAMILY

KW	TACTICAL						PRIME	
	PRECISE		UTILITY				UTILITY	PRECISE
	DED		DED	GED			DED	DED
	60Hz	400Hz	60Hz	60Hz	400Hz	DC	60Hz	60Hz
0.5				X	X	X		
1.5				X	X	X		
3	X	X	X	X	X	X		
5	X	X	X	X	X	X		
10	X	X	X	X	X	X		
15	X	X	X				X	X
30	X	X	X				X	X
60	X	X	X				X	X
100	X	X	X				X	X
150	X	X	X				X	X
200	X	X	X				X	X
300	X	X	X				X	X
500			X				X	
600-800			X				X	
1000-1200			X				X	
1500-2000							X	

DED: Diesel engine-driven
GED: Gasoline engine-driven

Figure 1

items to a total of 770 line items of which 43 were coded standard, 70 were coded limited standard, and 657 were coded nonstandard and keyed for elimination. The 70 items coded as limited standard were those that would be procured and supported until the 43 standard items, the DOD Standard Family, were fielded.

The second action, that of halting the continuing proliferation, was also taken under the Standardization Program. Military Standard 633B, a fully coordinated document, was published listing those "purified" items that could be procured by the Military Services until such time as the DOD Standard Family was fielded. Procurement of any item not listed in Military Standard 633B required the specific approval of the project manager. Military Standard 633B has been updated by publication of 633C listing only members of the DOD Standard Family. As members of the Standard Family are eliminated or new improved members are added, Military Standard 633 will continue to be updated providing a continuing ready reference of generators available to the users.

The third action was developing the necessary standardization documents and procurement data packages necessary to field the DOD Standard Family of Mobile Electric Power Source. Under the standardization program, preparation of fully coordinated specifications was directed that, when implemented by selective procurement practices, would field the first generation family acceptable to all Services. Responsibility for preparation was allocated to an individual Military Service based upon its past experience, predominance of use and manpower availability. The resulting specifications describe generators meeting the requirements of all Services.

Project Management Tools

Basically, the management tools used by the Project Manager for Mobile Electric Power, with one exception, were all available and existed under the DOD Standardization Program and current procurement regulations and policies.

There are serious weaknesses, however, inherent in the DOD Standardization Program. In the immediate area of engine generators where we exercise control through the Standardization Assignee Activity, the major shortfall is one of timeliness. Completion dates are never met and are constantly rescheduled due to higher priority tasks, lack of sufficient in-house personnel, or a myriad of other reasons. Expedited action can only be achieved if the preparing activity, representing a Military Service, has an overriding interest or need for the project assigned. Even this can be drawn out by non-receipt of another less interested Service's comments.

To overcome this situation, we have made maximum use of the "working group" method. By this method, we can address comments concurrently rather than consecutively. A Service representative is not nearly as obstinate about his position or requirement when he must defend it before his peers assembled from the other Services. Without direct line authority over the various preparing activities and the authority to assume concurrence when comments are not received on time, this tedious and long drawn out standardization process can only be alleviated in part and not eliminated.

A far more serious weakness exists in the peripheral areas where we lack Standardization Assignee control or influence. A case in point involves the area of electromagnetic interference, represented by MIL–STD–461 (Requirements) and MIL–STD–462 (Methods of Test). Theoretically, these documents are standards subscribed to by all Services. In practice, however, the rules allow for a Service to abrogate this concept by bringing out a "notice" to the standard. These notices seem to be published almost at will and without need for prior approval by the other Services involved. In this case, both the Air Force and the Army have produced their own notices to MIL–STD–461, changing the electromagnetic interference limits for engine generator sets. As one might guess, they conflict with each other and, as a result, we have no standard at all.

Efforts for the last two years to resolve the differing notices and publish a true Military Standard have been unsuccessful. The lesson to be learned is that within the tolerances of the Standardization Program, one or two individuals can literally procrastinate forever and, in fact, thwart the standardization bible, DOD Directive 4120.3M. Until such time as a supreme court type body is formed that can and will make prompt decisions in an area of con-

troversy, this unacceptable situation will continue unabated.

Joint Procedures

The one unique tool that had to be developed by the Project Manager for Mobile Electric Power was joint operating procedures. These procedures, which apply specifically and solely to engine generators, are drafted by the project manager and are published, after being fully coordinated, as a joint regulation. Encompassed under joint operating procedures are such functions as procurement, production, configuration management, deviations, initial provisioning, research and development, and maintenance standards, to mention but a few.

Implementing the actions under the Standardization Program are those selective procurement policies directed by the project manager. A major concern was the apparent conflict between standardization and procurement competition objectives. The two present a dichotomy of concept, yet each is of utmost importance.

To overcome this dichotomy and to assure not only standardization but also allow for maximum procurement competition, all high density tactical engine generators are military design sets. Under this concept, the Government owns full rights in data and is in possession of complete drawings of all components of the engine generator set except the engine. These drawings on Government paper to Government standards combined with the applicable specification constitute the procurement data package. Applying this concept, parallel or subsequent procurements utilizing the procurement data package results in the same sets year after year and yet allows manufacturers or assemblers, big business or small business, to actively compete for procurements.

Commonality Approach

Within the broad guidance previously described, specific actions were taken regarding the DOD Standard Family of Mobile Electric Power Sources.

While the necessary specifications were being drawn up by a working group composed of representatives of the three Military Services, continuing efforts were made to further reduce the designated DOD Standard Family. In-depth examination revealed that many of the designated ratings were of marginal value at best, while some applied to sets for which there was no foreseen requirement for at least the next five years. The results of this continuing evaluation, reevaluation and stringent challenge are indicated in Figure 2 (page 16). This represents a reduction of approximately 35 percent and results in a first generation DOD Standard Family consisting of 35 generator sets.

To further reduce the logistic burden, the greater the degree of commonality that could be achieved in the Standard Family members would, in turn, accomplish a complementary reduction of the family of end items. In this regard, three solicitations were issued requesting technical proposals covering the 15 through 200 kw tactical generator sets.

It would have been desirable to issue only one solicitation; however, the impact upon industry, especially small business, prohibits this method of attack. Therefore, in full coordination with the Small Business Administration, three solicitations were issued, one for the 15 and 30 kw, one for the 60 kw, and the last for the 100 and 200 kw sets. Each of these solicitations required proposers to indicate the degree of commonality which they could achieve both horizontally, *i.e.*, within a power rating, and vertically, between power ratings. The commonality matrix was one of the key factors evaluated to determine those proposals which were acceptable or unacceptable.

To prevent over-complication of the basic engine generator, major use of the kit principle was directed. Thus, starting with a basic set, a precise kit can be added for the user requiring a particular quality of power, *e.g.*, various winterization kits for the cold weather user and load bank kits for the user operating for prolonged periods at reduced power.

Product Improvement

Also, considering the state of the art, the solicitations contained a product improvement requirement covering the needs of the Military Services for a period of three years. This allowed the contractors to prorate their nonrecurring costs over the maximum number of units, thereby reducing unit costs of the end items.

A different concept was used for the 5 and

DOD STANDARD FAMILY OF MOBILE ELECTRIC POWER SOURCES

KW	TACTICAL								PRIME
	PRECISE		UTILITY						UTILITY
	DED		DED		GED			GTED	DED
	60Hz	400Hz	60Hz	400Hz	60Hz	400Hz	DC	400Hz	60Hz
0.5					X	X	X		
1.5					X		X		
3					X	X	X		
5			X	X	X	X			
10			X	X	X	X			
15	X	X	X						
30	X	X	X					X	
60	X	X	X					X	
100	X	X	X						
200	X		X						
500			X						X
750									X

Figure 2

10 kw tactical diesel driven sets. No Military Service had a satisfactory generator in this category; there were no firm funded requirements allowing a product improvement contract. Hence, industry was solicited to submit proposals for a limited number of prototypes in this power rating. Available funds allowed selection of two proposers scoring the highest in the technical evaluation, commonality and reliability areas. The prototypes were put through a prototype runoff. At the conclusion of the runoff, those sets meeting all specification performance characteristics and deemed to be the most reliable and most maintenance-free were designated as members of the DOD Standard Family.

An option in the solicitation allowed the Government to procure the full rights in data including drawings to Government format for the generator sets selected, excluding the engines. Quantity procurements can now be made under fully competitive conditions and will result in standard sets, regardless of contractor.

Project Benefits

The benefits and savings accruing to the Government, specifically through standardization and reduction of military components, are both tangible and intangible. The reduction from 2,000 to 35 makes and models will result in an annual management cost reduction from $85 million to approximately $2 million. These figures do not include the cost of the hardware but only those costs associated with management such as cataloging, procurement overhead, supply support, maintenance support and documentation to include manuals.

In procurement, by coordinating and consolidating the requirements of the Military Services for a standard item rather than multiple items, the benefits of larger quantities, more competition, and subsequent lower unit costs are achieved. The initial procurement of the diesel members of the first generation family was done under a three-year contract. This multi-year product improvement concept for 15 different power ratings and modes eliminated pure R&D and the cost associated with such development. Any development costs incurred are minimal and included with the three-year procurement quantities. Best estimates indicate an R&D cost avoidance of $500,000 per set

totaling $7.5 million.

Although tangible dollar savings are important, the other benefits, basically intangible and non-quantifiable, are even more important. The benefits of being able to train maintenance personnel on a limited number of standard sets will improve dramatically the caliber and qualification of maintenance personnel at no extra costs in funds, facilities, or time. Again, through maximum commonality, interchangeability, and standardization of parts, the weight and cube of parts which must be carried as prescribed load lists by units in the field will be greatly reduced, even though stockage of the high mortality parts will increase thereby assuring greater generator availability. Further, all Military Services will be using the same generator sets giving field commanders far greater flexibility in emergency situations to divert either end items or parts to the unit with the most critical need. Because the sets are standard to all Services, no emergency training will be required on diverted sets from another unit or Service.

Reliability is not necessarily a function of standardization and item reduction. Reliability has been stressed, however, in each specification prepared for standard family members. Contractors are being required to demonstrate a 95-percent reliability for a 24-hour mission at a 90-percent confidence level for tactical sets and a 98-percent reliability for prime sets.

All of these intangible and non-quantifiable benefits lead inexorably to one result—increased reliability and greater availability.

The actions directed by the Department of Defense through the Project Manager for Mobile Electric Power will result in dollar savings from a DOD viewpoint, more flexibility and shortened response times from both a DOD and Military Service component viewpoint, reduced unit loads for troop units and, most importantly, greater availability through increased reliability and more comprehensive training. The DOD Standard Family will accomplish the actions directed by the Secretary of Defense and will preclude the recurrence of the engine generator problems evidenced in Vietnam. □

Effective leadership depends primarily on mediating between the individual and the organization in such a way that both can obtain maximum satisfaction. — Warren G. Bennis

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Standardization = Taxpayer Savings + Improved Performance

Contracts with the Defense Department impose various requirements upon the contractor which may be considered above and beyond what would be expected from a customer on a normal commercial type contract. Of all of the imposed requirements, there is probably none as mutually beneficial to both the customer and the contractor as the requirement for standardization.

Standardization, on a big program or a small program, on a defense program or a commercial program, provides many interrelated advantages. These include reduced item cost through use of readily available items, reduced assembly and installation costs for items as a result of standard tooling, more predictable reliability through use of items with established service histories, reduced numbers of total types of items requiring initial procurement and subsequent logistics systems, improved maintenance by elimination of odd or unusual items, and reduction of testing and qualification, all of which adds up to improved potential for meeting schedule and cost goals through elimination of duplicative hours and costs required for development and use of similar items.

by W. F. Rockwell Jr.
Chairman of the Board and Chief Executive Officer
Rockwell International Corp.

Opinions expressed herein are those of the author and not necessarily those of the Department of Defense.

Corporate Standardization Program

The defense contractor must have a standardization program, at least to some extent, not only because it makes good sense but also because he must be in a position to respond to Government requirements. And just as the Military Service customer must judiciously allocate direct funding for standardization based on overall funding provided by Congress, so must the contractor allocate his money based on the amount available to him, or perhaps on the amount he is willing to allocate to standardization. In the case of a DOD system program contract, the extent to which standardization is desired will be spelled out in the contract statement of work. Thus the contractor's price for standardization will be based on this requirement. Standardization on a given program, therefore, becomes a design to cost trade-off, much like a weight to cost trade-off. It's a very good thing but there is always a question as to how much of a good thing you can really afford.

The North American Aerospace and Electronics Groups, with a number of divisions developing different types of end products, are not unlike the Defense Department with a number of its components developing different

defense systems. The advantages of standardization among these divisions was, and is, obvious not only for Rockwell International but also for DOD, the ultimate customer of many of the systems developed and under development by these divisions. The first effort in this direction was initiated by North American Aviation (now part of Rockwell International Corp.) in 1957, and resulted in the establishment of a substantial number of corporate drawings for company standard parts used by two or more divisions, as well as a number of corporate guidelines for standardization documentation.

In 1966, North American Aviation initiated a formal Corporate Engineering Standards Program encompassing all divisions of the corporation. This included Atomics International (nuclear power), Autonetics (electronic systems), Columbus (missiles and Navy aircraft), Los Angeles (now the Air Force B–1 aircraft), Rocketdyne (rocket engines), Space (space vehicles), and Tulsa (aerospace subcontracting). The standards program is now directed by the North American Aerospace Group Offices and is funded by the Aerospace and Electronics Group divisions on an equitable basis. All technical work is accomplished by engineering personnel at the various divisions. The program covers three prime technical areas: Preferred Parts for use in design, Standard Design Practices for use in design, and Drafting Standards for use in preparing engineering drawings.

Preferred Parts

The *Preferred Parts* have been selected from the major defense and space systems developed by the divisions such as Minuteman, Mark II Avionics, Apollo, Saturn, AJ Vigilante and B–1. This selection emphasizes parts already in the defense supply system and includes airframe, mechanical, fluid mechanical, and electrical and electronic type parts. They are documented in a manner to assure selection by the designer in accordance with the requirements of MIL–STD–143 which establishes the order of precedence for selection of standard parts. Two thousand parts are included in the Preferred Parts system. Normally, four hours of technical effort is required, including compiling the drawing, approved source list and test history, to prepare a part for inclusion as a preferred part.

Standard Design Practices

Standard Design Practices have received a significant amount of attention in this program. The availability of uniform and proven design practices for use by the designer is an important prerequisite to achieving well balanced standardization of parts, components, installations and assemblies. The Aerospace and Electronics Groups' Standards Program has generated approximately 300 Standard Design Practices which are in use throughout the various divisions of the two groups. These provide detail design guidance on such technical subjects as machining, sheet metal forming, casting, forging, welding, materials, nuclear hardening, electrical and electronics, etc. These practices are prepared by specialists in their fields and are coordinated among all divisions prior to their publication. A typical practice requires about 200 hours for complete preparation. Normally, there are between 50 and 75 practices in the preparation and coordination pipeline, of which 75 percent are new and 25 percent are revisions. These practices are updated as required, and new ones are prepared as the need arises on a priority basis depending upon their applicability across-the-board at all divisions. The Standard Design Practices, as their name implies, represent the most economical and technically logical approach to solutions of normal design problems and result in designs within the capability of existing manufacturing state of the art at all divisions.

Group divisions are allowed two weeks for review and comment on both parts and practices during the coordination cycle. Soft-bound illustrated indexes are published which provide rapid indexing to all items and subjects. Preferred parts drawings are available in four soft-bound volumes, and practices in 15 volumes broken down by subject. Thus it is convenient for the designer to retain at his drawing board only those volumes required for his design specialty.

Standardization of parts and practices is a dynamic, fast moving discipline. New and improved parts and practices are constantly emerging and providing significant advantages

to both Rockwell and DOD. To take advantage of this, the Group program has been purposely designed to allow rapid inclusion of new parts and practices and removal of outdated ones. All parts and practices are reviewed on a scheduled basis and revised as required. Automatic distribution of the revision is made by direct mail to all design recipients.

Standard Drafting Practices

Similarly, *Standard Drafting Practices* have been developed in coordination with all divisions. These cover the manner in which engineering drawings must be prepared and include such subjects as dimensioning, tolerancing, projections and views, abbreviations, etc. All drafting practices meet the requirements of MIL–D–1000 and MIL–STD–100 and, significantly, they are mandatory for use by all divisions. This assures the drawings of all North American Aerospace and Electronics Group divisions meet Government drafting standards.

Three primary ingredients have made this program a success:

- Strong and active support from top management at all divisions.
- Sound technical base of data.
- Easy access and availability of the data for the designer.

Budget and technical approval starts with the Engineering Senior Executive Council, composed of each divisional Engineering Vice President and headed by the North American Aerospace Group Vice President—Research and Engineering. Technical guidance is provided by an Engineering Standards Committee.

B–1 Standardization

With the advent of the B–1 bomber program, the first opportunity was afforded to apply the North American Aerospace Group Standards Program to a completely new DOD contract. The initial B–1 statement of work was very comprehensive in respect to standardization, and enabled the Aerospace and Electronics Group Program to provide all of these requirements within its existing structure. This included such requirements as preferred parts lists, retention of parts qualification test data, and uniform design practices, all applied to both the prime contractor and subcontractors. To reduce costs for direct standardization effort, this statement of work was revised to assure standardization to the greatest extent feasible rather than being wholly comprehensive. On an air vehicle the size and complexity of the B–1, this still represents an extensive effort within available funding.

To be successful, standardization must be designed into the aircraft from the very beginning. This means the designer must have adequate parts and practices documents at his fingertips when he begins his design. On the B–1, this capability was immediately provided by the Group standards documents. For example, the Group Preferred Parts List was screened and of the 2,000 parts available, 800 were approved for use on the B–1. At the midway point of total B–1 drawing release, 85 percent of all parts called out on drawings were preferred parts showing an extremely high level of standardization, particularly for an RDT&E program. Similarly, engineering drawings going through the checking procedure prior to release show a very high conformance to standard design practices.

A computerized programmed Preferred Parts List has been developed to monitor the use of preferred parts on the B–1. The computer compares actual parts callouts on drawings with the preferred list and, thereby, exposes all non-preferred parts for subsequent approval or elimination action. It also provides detail data on parts usage as required for management and planning. The Preferred Parts List is also provided to all B–1 subcontractors who are required to substantiate the use of other parts (see Figure 1).

Needless to say, not all of the parts and practices required for the B–1 design can be satisfied with existing off-the-shelf hardware or state-of-the-art fabrication capability. As a result it has been necessary to develop certain new standard parts and practices to meet these requirements. Examples of this are a new series of high strength bolts of PH13–8Mo material required for high stressed fatigue areas, and a new practice covering design of diffusion bonded structural components—a joining process which provides solid state bonding of wrought metallic details by application of heat and pressure. These have now been included in the Group standards documents and

are, therefore, available for use by all other divisions. In the case of the new bolts, although they are now Rockwell International standard parts, they can be converted at any time to either National Aerospace Standards (NAS) or Military Standards (MS) for industry and Government-wide use on other programs. Standardization technology developed for the B–1 will be incorporated into the Aerospace and Electronic Groups' Standards Program when appropriate.

Standardization on Other Programs

Unlike many aerospace engineering disciplines which are confined to aerospace applications only, standardization is a relatively flexible and widely applicable discipline. Standard parts and practices result in minimum costs expended for maximum reliability and production. The most economical light civilian airplane, for example, will make extensive use of MS and NAS standard parts, and its sheet metal fabricated parts will be designed to accommodate standard practices for hydropress forming, bend radii, joggling, etc.

The Atomics International Division of Rockwell participates in and makes full use of the Group Standards Program. From the standpoint of the Government, this represents a coordinated standardization effort to the advantage of both the Defense Department and the Atomic Energy Commission. In a similar vein, the Rockwell International Space Division Standards Program for the Space Shuttle will make maximum use of the Group Standards Program within the scope of the contractual criteria established by NASA. This will provide a strong starting base for standardization on the Space Shuttle and, for the Government, it will provide a level of standardization between DOD and NASA. Also, the Columbus Division utilizes the Group Program in its entirety providing DOD with strong, coordinated standardization between the Air Force and the Navy.

In a large sense, the DOD Standardization Program is a catalyst for the North American Aerospace and Electronics Groups' Standards Program. The two programs are compatible and have the same ultimate goals—cost savings and improved performance for the Government, for industry and for the American taxpayer. □

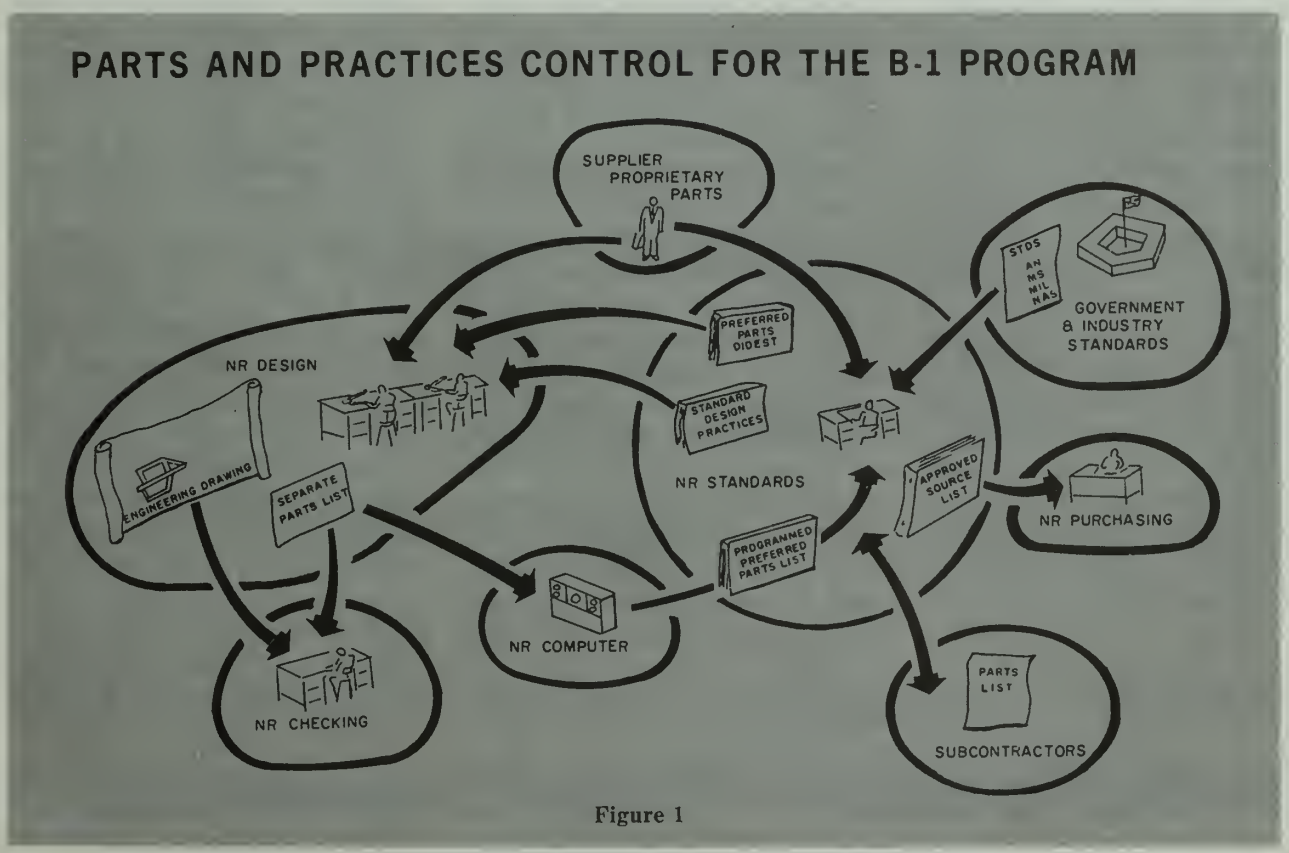

Figure 1

Standardization Offers Economic Opportunities

Great $avings Potential

In the past decade the Department of Defense initiated numerous specialized management programs aimed at effecting economy in defense. Programs such as life cycle costing, reliability, maintainability and value engineering are all examples which have, in some instances, achieved a modicum of success.

Despite this, acquisition and support costs have generally continued to increase. The cost growth or overrun problem and the phenomenal growth in unit costs have been widely documented and reported. Defense system operating reliability, despite the increase in component reliability, has frequently been disappointing due to increases in complexity during attempts to reach the extreme performance edges of the state of the art.

These facts have resulted in fresh approaches to cost control. DOD Directive 5000.1, "Acquisition of Defense Systems," has made cost a principal design parameter which has led to the concept of design to a cost, a philosophy which is now embodied in many recent major defense programs.

Design to a cost represents a major shift in philosophy from past R&D priorities of performance first, schedule second and cost third. Production and support costs now receive equal priority with performance, with schedule a poor third. Trade-offs of cost, schedule and performance are encouraged. The economic interaction of design philosophy and production and support costs no longer permits compartmentalization of functional interests if a life cycle cost approach is to be meaningfully implemented.

As recognition of these realities has spread, DOD management began examining ways and means of translating the new objectives and priorities into meaningful end results. In this process a number of the specialized management programs are being reexamined to determine what role they can serve in supporting the new DOD engineering philosophy of design to a cost. Since the adequacy and economy of specifications and standards has been the subject of continuing concern to both industry and DOD, standardization was selected for early review. Because of current cost pressures, one key facet of these studies concentrated upon the economics of standardization. This review is confined primarily to an examination of existing studies and cases currently available.

by R. E. Biedenbender
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Measurement

In this day of measurement,

the uninitiated would expect the economics of standardization to be clearly documented as many other areas of cost benefits in DOD have been in the past 10 years. This is not the case. While bits and pieces exist, there is no commonly accepted system in being for this purpose. The reasons for this condition are many. Three significant ones are:

• *Measurement of standardization savings is generally complex and therefore costly.* While general measurement models have been constructed, a model covering total benefits has as many as 52 factors. The Aerospace Industries Association (AIA) has issued some nine National Aeronautical Standards,[1] each of which covers a segment of possible standardization savings. The models for each of these standards, taken collectively, are still not complete from a DOD viewpoint. The models for savings for consumables, for example, must obviously be different from the model for repairables. Some areas of potential savings, such as reliability, may be offsets in one case and additions in another. Lastly, most models provide, at best, estimated savings rather than actuals.

• *Benefits are dispersed.* Standardization benefits are fragmented across the system life cycle. They can occur in engineering, procurement, production, maintenance, supply and operation.

• *Standardization has had low engineering priority.* With past emphasis on performance, the engineering community has all too frequently regarded standardization as an attempt by logisticians, assumed to be the chief beneficiary, to needlessly constrain the designer, if not make his job impossible.

[1] *National Aerospace Standard No. 1524, "Standardization Savings, Identification and Calculation."*

Potential Benefits

Overall estimates of total savings DOD-wide are difficult to find. However, there are three studies containing general estimates of savings that could be attained through a more concentrated application of standardization. All have limitations in approach to areas considered and types of savings estimated. They are:

• Logistics Management Institute (LMI) report of 1963, "Study of the DOD Standardization Program."

• Air Force Systems Command (AFSC) estimate of 1971.

• Aerospace Industries Association (AIA) study of 1971.

The LMI report contains dollar estimates of savings in parts or components, subassemblies and major assemblies, considering cost factors in the life cycle of major weapon systems such as engineering and test, documentation, procurement and production, provisioning, training, maintenance and repair, and supply and logistics. While 1963 dollar figures appear in the report and would be considerably greater converted to 1973 dollars, the findings of the study indicate potential cost benefits from a wider application of standardization in systems development and acquisition. LMI's figures are only estimates, but they do give some glimmer as to what might be saved. Some examples of estimated savings in the LMI report are:

• *Engineering and Test* reflecting savings that can accrue during design and development using proven and known parts or components. Typical estimated savings in parts or components are $500 to $7,000; subassemblies, $10,000 to $15,000; and major assemblies, $33,000 and up.

• *Documentation* including the full range of reports and data procured as part of the acquisition process. Typical estimated savings in parts or components are $50 to $500; subassemblies, $2,000 to $25,000; and major assemblies, $100,000 and up.

• *Procurement and Production* considering reductions in unit costs due to competition as well as larger production runs resulting from use of standardization. Estimated savings in procurement activity costs (not costs of the item itself) in parts or components are $25 to $100; subassemblies, $100 to $1,000; and major assemblies, $1,000 to $10,000.

• *Supply and Logistics,* not including inventory. Typical annual estimated savings in parts or components are $750 plus $300 per annum; subassemblies, $2,000 to $100,000; and major assemblies, $100,000 and up.

This study projected a very conservative average saving of $1,500 per item in data, qualification, test and supply logistics costs. Based upon a potential reduction of 200,000 items per year, savings of $300 million could be projected. In terms of 1973 dollars, this amount would be much more.

The AFSC estimate was made in 1971. It was confined to the mechanical area and involved *only* Air Force savings. The study estimated savings of $103 million annually if a major effort

were mounted. Factors included in the savings were drawing elimination, qualification test elimination, Federal stock number elimination, drawing maintenance and competition. A five year cycle was assumed. An increase in competition from 40 to 90 percent was projected. While this may seem high to some observers, other aspects of the estimate tend to the conservative side. Projecting this estimate to the electrical and electronic areas and extending it to the Army and Navy, a "ballpark" estimate of one-half billion dollars seems reasonable to some observers.

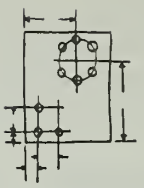
The third general estimate was made in 1971 by AIA. This study indicates possible savings in the range of $200 to $500 million, depending upon factors considered and the statistical method adopted. These estimates considered costs of redundant drawings and needless qualification testing, of specification/source control document presentation, the cost of item entry control, and the cost of technical data management.

To summarize these general estimates, all were done differently, none were all-inclusive in the savings considered, all were "piece part" oriented. Yet all fell in the same "ballpark." Considering these limitations, particularly the lack of any estimates at the subassembly or major assembly level, potential savings of $500 million per year appear very conservative.

Specific Examples

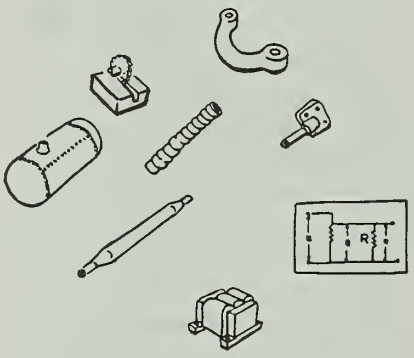
Now let's look at some specific examples of current savings in these areas:

• *Drawings.* The F–15 program eliminated some 2,800



drawings at a direct savings of $8 million (drawing cost only). An additional $7 million savings is expected through elimination of 700 microelectronic drawings.

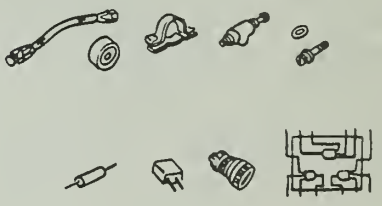
• *DOD Parts Control Project.* This project was conducted in the area of electronic parts. Estimated savings, including cost factors such as engineering search time, drawing development, non-standard part testing, justification, approval and cataloging, were $2.3 million for an investment of $170,000.



• *Electronics Procurement.* Procurement of transistors, diodes and thyristers at the Defense Supply Agency's Defense Electronic Supply Center (DESC) is generally cheaper when military standard rather than commercial items are purchased. The average military part is $1.68 cheaper. If DESC could purchase all military items, it would save $3.25 million per year. Conversely, purchase of all commercial would increase costs of the components by $1.25 million.

• *Minuteman Parts Control* in the command data buffer, hardness command and control, and improved digital controller unit. Savings included almost $3 million in one-time acquisition savings (specifications, quality test, etc.). Estimated 10-year logistic savings in avoidance of 396 Federal stock numbers are $4 million.

• *Fasteners.* The estimated savings by designing to use standard[2] fasteners (rivets, pins and collars, blind fasteners, and



bolts and nuts) on the F–15 are $128,000 per aircraft—about 1 percent of total unit cost.

Most documented savings from standardization appear to be at the piece part or drawing level. But a few examples exist at higher levels.

One interesting study was made in 1966 by the Logistics Management Institute[3] on the then planned Navy Fast Deployment Logistic (FDL) ships. For a 20-ship production run at an anticipated unit ship cost of $35 million, vigorous use of standardization practices was estimated to save in excess of $88 million. Use of standardized existing components and equipments accounted for $72 million. The remaining estimated savings were in the areas of technical data and manuals (about $6 million), and support costs such

[2] *Presentation by E. L. Wall to 1972 ASM Materiel Engineering Congress, "Application of Mechanical Fasteners in Current Aircraft Design."*

[3] *LMI Report "Standardization Objectives for the FDL Ship Program," 1966.*

as preparation and validation of Coordinated Shipboard Allowance Lists (COSALS), standardized planned maintenance system, and inventory management (about $10 million). The FDL program was cancelled, but many of the principles of this study were incorporated into other programs. A check with a major commercial company which had made a rigorous study of standardization benefits revealed annual estimated savings in the order of $25 to $30 million.

Summary

While the purist accountant or economist might be disappointed at the lack of completeness, comparability and general paucity of documented work on the dollar benefits of standardization, there can be little doubt that standardization can mean big savings. This has been shown during a period when standardization considerations were on the "back burner" because of tremendous pressure on performance, and when standardization effort was concentrated on bits and pieces with little effort at the major assembly level. In the light of the new cost concern imperatives, the future potential of standardization would appear far brighter than its contributions in the past.

Perhaps the creation of a DOD Specifications and Standards Board, as discussed elsewhere in this issue, will provide the management impetus needed to capture this potential. Meanwhile DOD program managers would be well advised to review their plans for applying standardization as an aid in achieving design to cost goals. Like many other things, standardization must reflect conscious consideration in major engineering and economic decisions made in the development of new defense system programs. □

AFMA Annual Conference

The 18th Annual Armed Forces Management Association (AFMA) Conference, originally scheduled for March 26–27, has been re-scheduled for June 7–8 at the Statler Hilton Hotel, Washington, D.C. The theme of the conference will be Department of Defense in an Era of Peace.

The Nuts 'n Bolts of F-15 Standardization

The complexity of new systems combined with budget constraints confronts the Defense Department and the defense industry with a serious dilemma. The situation clearly indicates a need for the most effective management efforts to reduce costs while still retaining the integrity of our defense systems to provide for the Nation's security.

One such effort is the approach and experience of parts standardization and control applied in the F–15 fighter system program. A key factor in the success of the F–15 Standardization Program is the Parts Control Board, the chief purpose of which is to provide the staff of the Air Force F–15 System Program Office (SPO) and the management of the prime contractor, the McDonnell Aircraft Co. (MCAIR),[1] with visibility and control related to parts evaluation, selection, documentation, problems and solutions.

The F–15 SPO required the submittal of a Program Standardization Plan with each proposal. Subsequently, the F–15 contract established the Program Standardization Plan as a contractual requirement. The Parts Control Board, in a solely advisory capacity, assisted the prime contractor in designating significant part standardization tasks for which schedules and responsibilities of the board members were assigned and monitored.

by Terry E. Utz
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McDonnell Aircraft Co.

Opinions expressed herein are those of the author and not necessarily those of the Department of Defense.

F–15 Parts Control Program Overview

The F–15 Parts Control Program is illustrated in Figure 1 and shows a Parts Control Board (PCB) chaired by MCAIR with major subcontractors and USAF SPO participating.

The PCB provides timely identification, assignment and monitoring of required F–15 parts standardization tasks. Candidate parts for the automated Preferred Parts List (PPL) are also discussed and recommended by the PCB. Parts accepted by the prime contractor for inclusion in the PPL are stored by part number in a computer and the list is updated as required. Designers of the prime and subcontractors, with the aid of PPL copies, select and list parts for their application on automated parts lists, *i.e.*, Equipment Parts Lists (EPLs) and the MCAIR Automated Drawing Parts List System (ADPLS). These automated parts lists are matched to the PPL by computer, resulting in a diagnostic report listing all nonstandard parts (NSPs)—parts not listed in the PPL. A copy of this report goes to the F–15 Standards Engineer who resolves all NSPs with the appropriate designer of the prime or

[1] *Technically the McDonnell Douglas Corp. is the prime contractor on the F–15 system program. McDonnell Aircraft Co. is a corporate division.*

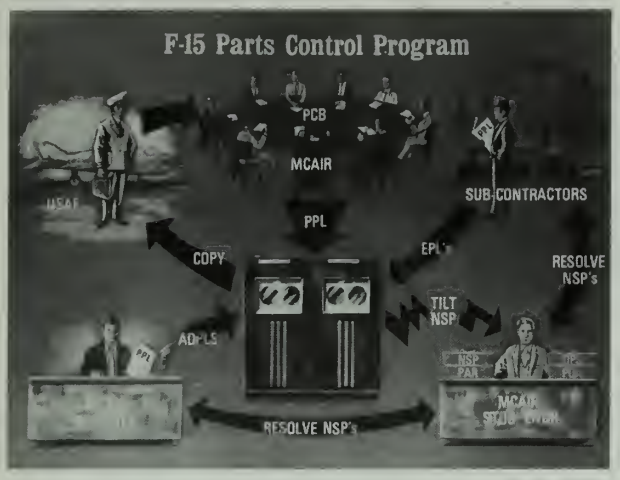

Figure 1

subcontractor.

The Parts Control Board is responsible for providing the F–15 SPO and MCAIR management with parts standardization visibility and control on a timely basis and in an informal manner. As previously mentioned, the PCB serves in a solely advisory capacity, assisting the prime contractor in the implementation of the F–15 Parts Control Program.

Organizationally, the F–15 PCB is composed of representatives from the Air Force F–15 SPO and its advisors (the Defense Supply Agency's Defense Electronic Supply Center, and the Air Force Systems Command's Aeronautical Systems Division and Rome Air Development Center), the major subcontractors and the prime contractor. The representative of the prime contractor serves as the PCB chairman and is responsible for preparing and distributing meeting notices, agendas and minutes, and for conducting all PCB meetings. The frequency of meetings depends on the work load. Initially, monthly meetings were held. As the program progressed meetings were held less frequently as determined by the PCB chairman.

Major PCB Tasks

The major tasks of the F–15 Parts Control Board include:

- Candidate parts are presented, discussed and recommended for inclusion in the PPL.

- PCB subcontractor representatives are equitably assigned tasks to document new multi-application parts in military specification format for expeditious incorporation into the military standard drawing system.

- Parts and suppliers are evaluated as a continuing task by all PCB members and includes the monitoring of supplier performance throughout the F–15 Program.

- Parts information is interchanged and parts problems are resolved on a timely basis.

- PCB Information Bulletins are issued periodically by the prime contractor immediately following PCB meetings to keep F–15 non-PCB subcontractors informed of program parts standardization activities and progress, *i.e.*, PPL additions, new military specifications, qualification status, deficient parts, etc.

Results of F–15 Standardization Program

Headquarters, Air Force Systems Command, had reported during the development phase that a comparison of F–15 standardization with other Air Force aircraft systems showed the F–15 achieving significant standardization improvement. The timely management visibility and control provided by the Parts Control Board has contributed significantly to this accomplishment.

In specific part areas, other F–15 data shows the following improvements for high usage items such as:

- *Microcircuits.* A 13-percent microcircuit standardization has been achieved in the F–15 program versus 0 percent for all other previous DOD programs. It should be noted that there were no military standard microcircuits existing at the time of the F–15 contract award. The first military microcircuit slash sheets (M38510/1, /2, and /3) were prepared, coordinated and issued through the efforts of the F–15 PCB members working closely with representatives of the Aeronautical Systems Division, Rome Air Development Center and the Defense Electronic Supply Center. The F–15 PCB has generated over 20 military microcircuit slash sheets covering 80 different device types. In spite of their unavailability at program inception, F–15 subcontractors still managed to incorporate approximately 13 percent of them into their design applications. These F–15 PCB-generated military standard micro-

(please turn to page 53, col. 1)

How To Obtain Specifications and Standards

There are more than 350 different organizations developing and publishing specifications and standards in the United States. With this range of interest it is no wonder that obtaining a needed specification is of concern to many people. Although there is a maze of pathways to the sources of specifications and standards, there really is no mystery involved in obtaining them.

Specifications and standards are available by mail from the Naval Publications and Forms Center (NPFC) at 5801 Tabor Avenue, Philadelphia, Pa. 19120 or by calling the Center at (215) 697–3321. The Center is the distribution point within the Department of Defense from which thousands upon thousands of military specifications and standards are sent to manufacturers, students, Government procurement offices and engineering laboratories, to name a few categories of document users. The Center's publication, "Guide for Private Industry," provides some details of the NPFC operation and is available upon request.

NPFC prints and distributes all the military series documents and distributes within DOD the industry specifications and standards adopted by the Military Services. DOD procedures for adopting industry documents are contained in the Defense Standardization Manual 4120.3M.[1]

When contacting NPFC to obtain a copy of a military specification, the title and number must be known—or *at least the number*. In cases where the document is positively identified, there is virtually no difficulty in obtaining a copy. DOD requires no justification for ordering specifications or standards and there is no charge for a single copy. The real obstacle with which the requester is confronted is correct document identification.

One tool available to aid identification is the Department of Defense Index of Specifications and Standards (DODISS)[2] which lists approximately 25,000 current specifications and 10,000 standards. The National Bureau of Standards has a research service available to the public and publishes an index of U.S. Voluntary Engineering Standards[3] which contains a listing of nearly 20,000 documents and the sources from which they may be ordered. In addition, associations and professional societies each have indexes of their own publications.

Document Search Problem

The truly difficult problem confronting the engineer or ma-

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Directorate for Product & Production Engineering
OASD (I&L)

[1] *Available from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, at an annual subscription rate of $2.*

[2] *Available from the Superintendent of Documents, Government Printing Office, at an annual subscription rate of $20.*

[3] *NBS Special Publication 329, available from the Superintendent of Documents, Government Printing Office, at $9 per copy. It is also available in microfiche form at 75¢ per set. Inquiries regarding the research service should be addressed to: Information Section, Office of Engineering Standards, National Bureau of Standards, Washington, D.C. 20245, telephone (301) 921–2587.*

terials specialist, who possesses a general description and knows precisely what is wanted, is not knowing whether there is a formal specification or standard which accurately and completely covers the item or process in question. Although various efforts have been mounted to establish a method for researching, none have been adopted for broad use within DOD. Industries with which DOD interfaces have precisely the same problem. How does the engineer resolve the problem?

In almost every instance, the first solution selected by the project engineer is to cite a proprietary make, model, or part number with which he is familiar and can identify from a vendor catalog at hand. Even when he knows that other products are substitutable, he stops his identification effort at the first "hit" because his time is limited and other identifications must be made by him.

The second solution to the description dilemma is to prepare an original description of the features and attributes of the item, material, or process and to call out tests, etc. The new document is frequently a drawing, technical requirement, or a purchase description. At any rate, whatever its name, it comes into being because a responsive retrieval system was not available to still another technical researcher.

Retrieval Projects

As previously mentioned, *some* effort has been applied to solve the problem. For example, the Army Missile Command has pursued two projects, Army Data Retrieval Engineering System (ADRES) and Document Automated Retrieval Equipment (DARE), with some success. Defense Supply Agency's Defense Integrated Data System (DIDS), which has plans to provide characteristic search for stock numbered items, is another option for consideration.

There has been only a little effort applied to comprehensive indexing and cross-referencing. Synopsizing or abstracting the purpose and scope of specifications and standards to provide an easy "look up" and preliminary review mechanism has not been attempted to our knowledge; nor has an "applications" approach been attempted to bring together devices proved by experience to be suitable in stated environments.

Savings Potential

Albeit these approaches will consume valuable time and resources, they may have a potential to save the thousands of engineering hours now spent on fruitless document searching or on the preparation of duplicative specifications in and out of Government. It can be concluded that a market survey to ascertain usefulness of these techniques would be a sound investment toward resolving the near and long term approach to a retrieval system for specifications and standards. The availability of current computer technology using peripheral equipment for input, time sharing, hard copy readout, etc., may well be the key to unlock the lost treasures of hidden specifications and standards.

In the interim, documents which can be identified by title or number are obtainable with a modicum of effort. There are, in addition, various indexes to assist in identifying documents and their sources. The greater problem, *i.e.*, determining the appropriate document for reference and use, continues to bug us and, perhaps, will continue to do so until a national effort is applied to the development of a central system for identification and retrieval which is practical for use at the local plant level. □

Technical Data Management— Progress and Problems

Every year the Defense Department buys about $2 billion worth of engineering drawings, purchase descriptions, technical manuals, specifications, test reports and other kinds of technical data. The cost of this technical data is not precisely known because much of it is hidden in hardware costs. It is high enough, however, to cause DOD to recognize that data represents an asset that must be managed with the same degree of attention as a costly hardware program.

Reduced to its essentials, three management objectives of DOD's technical data program are to:

- Provide for acquiring *all* the data needed to support the functions it is intended to serve, *i.e.*, design, supply, maintenance, procurement, cataloging, standardization, etc.
- Set up controls to assure that *only* needed data is acquired, *i.e.*, only essential or cost effective data is bought.
- Ensure the data is effectively and efficiently handled after receipt, *i.e.*, made available to the user when he needs it at least cost.

The first two objectives relate to the data acquisition process and the third to data retrieval techniques. Intertwined in each of these are many relationships with the DOD Standardization Program.

Technical Data and Standardization

The fact that specifications and standards are components of the total reservoir of technical data makes fairly obvious the close relationship between the technical data and standardization functions. It may also be fairly evident that engineering data retrieval systems make data on existing items (including specifications and standards) available for new applications. This is an essential ingredient of standardization.

Not so evident perhaps is the fact that the inherent engineering disciplines of technical data and standardization are the same. Part numbers given in specifications and standards are used on engineering drawings. Part numbers provided by drawings must be compatible with part numbers given by specifications and standards in structure and in criteria for change. For example, when technical data problems result from lack of uniformity in microfilm types and sizes, drawings practices and conventions, and technical manual formats, we turn to the DOD Standardization Program for solutions. This uniformity is essential so the data can be used effectively and interpreted consistently after receipt from contractors.

With respect to the acquisition process, no one should decide for the weapon system program manager the data he needs to acquire for his program. It would be presumptive to attempt to lay down hard rules to tell him what data he can or cannot purchase from contractors. We can, however, make him conscious of the relative importance and cost of data; we can give him a system that makes the data he is ordering clearly visible to him so he can add and delete requirements; and we can provide control techniques he must use.

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The Way It Was

Prior to the early 1960s, data requirements appeared in many different forms including speci-

fications, contract exhibits or addenda, standards, contract scope of works, and in layers of referenced documents. It was charged there was duplication because no one orderer of data knew for what another was asking; there was overlap and redundancy for the same reason; there was much unnecessary data ordered because there was no easy way to learn exactly what was being ordered; data requirements were not well written because nobody checked them; no one knew how much the data cost because no one asked; and no one worried much about what and when data was delivered because the process was a contract administration nightmare. All this was true to an uncomfortable degree.

Key people in the Department of Defense became concerned. Industry associations began to take notice. One industry evaluation worthy of note is contained in "A Cost Reduction Study," issued by the National Security Industries Association, dated June 15, 1962. The House Appropriations Committee started to ask questions. Annual discussions between that committee and DOD officials on technical data matters are contained in records of hearings on defense appropriations before the committee in the mid-1960s, especially for FY 1964, FY 1965 and FY 1968 appropriations. This attention resulted in action within the Military Departments and the Office of the Secretary of Defense.

DOD Directive 5100.36, "Department of Defense Technical Information," Dec. 31, 1962, assigned responsibility for the Technical and Logistics Data and Information Program to the Assistant Secretary of Defense (Installations and Logistics). A subsequent study led to the issuance of DOD Instruction 5010.12, "Determination of Requirements and Procurement of Technical Data and Information," May 27, 1964, which was revised and retitled "Management of Technical Data," on Dec. 5, 1968. The revised instruction provided basic policies, procedures and techniques which have withstood the test of time and, with some refinement still going on, control the data acquisition process today.

The Way It Is

DOD Instruction 5010.12 established procedures "calling" for data to be included in a contract, relating need to intended use, "scrubbing" requirements, delaying delivery until needed, pricing data on contracts, and others. Two techniques or tools provided by this instruction, the Authorized Data List and the Contract Data Requirements List, are so fundamental as to deserve explanation.

To combat the proliferation of similar descriptions of data requirements in many different types of documents, a single form, DD 1664, "Data Item Description," is specified for use. Data Item Descriptions must be approved and listed in an *Authorized Data List*. Any data description not on the Authorized Data List is subject to special approval before it can be used in a contract.

To give necessary visibility for control in any given contract, Data Item Descriptions may be applied in a contract only in one place, the *Contract Data Requirements List*, DD Form 1423. The Armed Services Procurement Regulation states in paragraphs 7–104.9n and 16–815(b) that contractors may ignore requirements for data not on the Contract Data Requirements List. These two lists, together with procedures specified for their use, form the backbone of data management. These techniques and procedures work. How well they work depends on how aggressively the program is pursued on any given weapon system program.

The Way It Will Be

Much remains to be done. We do not believe we have come as close to achieving our goals in effective data acquisition as we can. Therefore, a new approach to management of the data acquisition function was instituted when DOD Instruction 5010.29, "Acquisition of Data from Contractors," was issued on Nov. 29, 1971. This instruction restates basic policies for acquiring data from contractors in simple, straightforward terms. It requires the Military Services to:

- Buy minimum essential data using contractors' formats whenever possible.
- Provide for objective challenge of data requirements proposed for contracts.
- Defer the ordering of data until the need is positively known and delivery until the need is at hand.
- Use uniform forms, procedures and data requirements among the Military Services.
- Issue a single joint implementing regulation under Air Force leadership to supersede

DOD Instruction 5010.12.

The joint regulation required by DOD Instruction 5010.29 will constitute a single implementing document, eliminating the need for separate, and often different, regulations that were necessary to implement DOD Instruction 5010.12. To ensure the new DOD Instruction 5010.29 is effectively implemented, the Office of the Secretary of Defense will review the joint regulation prior to publication.

A draft of the new regulation has been completed by a committee chaired by the Air Force and is presently being coordinated among the Military Departments and Defense Agencies. As might be expected, the basic procedures and forms provided by DOD Instruction 5010.12 have been retained in the new regulation as drafted. And, some significant new ones have been added.

One of the more promising new features in the joint document is the "accession list" concept. This is a simple but effective requirement that a contractor provide to DOD a list of the data he has prepared for his own use. Copies of data on this list are furnished to DOD on request for the cost of reproduction. Use of the accession list concept on the B–1 aircraft program has made it possible to reduce the formal DD Form 1423 list of data requirements at significant savings.

Another provision of the new joint document is a guide matrix showing the kind of program, type of contract, stage of development, and intended use of the data for which a given DD Form 1664 would normally be called out. This will provide a standard which can help in judging whether too much or too little data has been ordered on any specific contract.

All in all, the delegation of responsibility for operating details has caused greater individual involvement by the Military Services, with a resulting higher level of interest. This has been healthy and productive. We look forward to continued improvement in data acquisition as more new ideas evolve.

Data Storage and Retrieval

The handling of data *after* receipt does not have even the small amount of glamour that has been attached to data acquisition because of the high visible cost of acquiring data. There are no special policy oriented techniques or procedures for data storage and retrieval. Efficient and effective handling of data is the product of common sense, hard work and effort devoted to keeping abreast of data retrieval technology to take best advantage of it.

The important recent developments in data retrieval have been in the application of microfilm and computer technology. Every Military Service has or is looking into use of microfiche or 16mm microfilm cartridges in lieu of hard copy for technical manuals, just as most engineering drawing respositories changed to 35mm aperture cards 10 to 15 years ago (35mm is essential for larger drawings for reproduction quality).

Optical scanners are coming into use to reduce hard copy to computer memory where revisions can be made very efficiently with cathode ray tube/light pen techniques. Excellent microfilm quality outputs from computer memory are now possible with computer-output microfilm processes. Computer related processes are also coming into greater use for interchanging microfilm aperture cards among drawing repositories throughout the United States, and for locating existing data by describing the characteristics of the items shown on the data. The foregoing are just a few applications.

The Bad With the Good

The advantages that modern data processing and storage technology bring to the technical data world do not come without associated problems. We are already beginning to consider some of the problems that will result from the fact that conventional hard copy data may not be available in the future. It is already possible—though not yet practical—to design an item on a cathode ray tube with a light pen and produce that item on numerically controlled tooling, without preparing a piece of conventional data. In such an instance, what will DOD use for its organic functions of procurement, cataloging, maintenance, etc.? Should we pay extra to get conventional data? Can we use a modified form of data that might be generated directly from computer memory? What about part tolerances that the original producer may not have needed?

The solution of these kinds of problems and other problems associated with acquiring only the right kinds and amounts of technical data demands continued and intensive consideration by the Department of Defense. □

Technical Information Services Developed Through S&TI Program

The Defense Supply Agency (DSA) was established in 1961 as a result of the Defense Department's steps in the early 1960s to consolidate logistic support activities to increase efficiency and reduce costs. DSA is responsible for providing wholesale military supply support and consolidated contract administration services to all DOD components.

In that same period, it became apparent that a central support system was needed to supply scientific and technical information to the defense scientific and engineering community. Scientists and engineers were finding it increasingly difficult to obtain information generated in the rapidly advancing technical environment resulting from the technological expansion after World War II. The traditional library system was not designed to provide the support required. To fulfill this need, the Department of Defense initiated a series of actions early in 1963 to create an effective Scientific and Technical Information (S&TI) Program under the management of the Director of Technical Information in the Office of the Director of Defense Research and Engineering.

The new program recognized the need for a central document depot and supply activity, specialized information centers, local retail activities, *i.e.* technical libraries and the producer-user functional activities. The role that DSA was to play in the new program was indicated later in 1963 when the Armed Services Technical Information Agency was reconstituted as the Defense Documentation Center (DDC) and transferred from the Air Force to DSA.

Development and improvement of the S&TI program have continued in a progressive manner since these early actions. As a result, a highly structured program exists to provide scientific and technical information, the "logistic support" needed by the army of scientists and engineers engaged in the defense research and development effort.

Documentation Center

Since assignment to the Defense Supply Agency, DDC has grown to be a central S&TI support activity of the Defense Department. Early in 1966 the Director of Defense Research and Engineering directed DDC to initiate an aggressive development program to devise new methods, processes and systems for improved storage, retrieval and distribution of S&TI documents. Principal achievements of that effort were a vastly improved search capability, the defense RDT&E on-line system, computer-aided indexing, and much shorter delivery times for a greater variety of information products.

Currently, in addition to the traditional technical report services for completed research and development work, DDC has the capability of providing information, either on-line or on request, concerning ongoing and planned research and technology efforts as well as referrals to other specialized information sources.

Several centralized RDT&E computerized data banks have been added to the DDC function, as well as the responsibility for developing new techniques, processes and S&TI service systems using existing technology. The advent of operational status for the defense RDT&E on-line system (with both keyboard and

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Defense Supply Agency

cathode ray tube type terminals) at DDC brings into focus some future possibilities for improving common support of defense RDT&E. Among these are using the:

- National telecommunications network for video-technical conferences, transmission of audio-visual state-of-the-art reports, laboratory demonstrations and exhibits.
- On-line computer for scheduling, announcing and monitoring technical meetings, and recording, printing, and disseminating DOD-sponsored conference proceedings.

Information Analysis Centers

With the development of DDC well underway at the beginning of 1964, there still remained the problem of accessibility to qualitative information to be found in hundreds of documents in the massive central collection. Many manhours were being expended unnecessarily by defense scientists and engineers to sift information from the mountains of literature available. Consequently in July 1964, by direction of the Director for Defense Research and Engineering, the DOD Information and Analysis Centers (IACs) were made a part of the DOD-wide S&TI support system.

The IACs are manned by scientists and engineers in highly specialized fields of technology. Some of the IACs are operated on a contract basis and the remainder are DOD in-house activities (see listing).

Each center gathers information in its clearly defined specialized area of interest, reviews, analyzes, evaluates, synthesizes, condenses, and summarizes the information, and pro-

DOD Information Analysis Centers

Defense Supply Agency

Chemical Propulsion Information Agency
Applied Physics Laboratory
The Johns Hopkins University
8621 Georgia Avenue
Silver Spring, Md. 20910

Electronic Properties Information Center
Purdue University Research Park
2595 Yeager Road
W. Lafayette, Ind. 47906

Infrared Information and Analysis Center
Institute of Science and Technology
University of Michigan
P.O. Box 618
Ann Arbor, Mich. 48107

Metals and Ceramics Information Center
Columbus Laboratories
Battelle Memorial Institute
505 King Avenue
Columbus, Ohio 42301

Machinability Data Center
Metcut Research Associates, Inc.
3980 Rosslyn Drive
Cincinnati, Ohio 45209

Mechanical Properties Data Center
Belfour Stulen, Inc.
13919 West Bay Shore Drive
Traverse City, Mich. 49684

Reliability Analysis Center
IIT Research Institute
10 W. 35th Street
Chicago, Ill. 60616

Thermophysical Properties Information Analysis Center
Purdue University Research Park
2595 Yeager Road
W. Lafayette, Ind. 47906

Defense Advanced Research Projects Agency

Strategic Technology Office Information Analysis Center
Columbus Laboratories
Battelle Memorial Institute
505 King Avenue
Columbus, Ohio 43201

Tactical Technology Center (formerly RACIC)
Columbus Laboratories
Battelle Memorial Institute
505 King Avenue
Columbus, Ohio 43201

Defense Nuclear Agency

Defense Nuclear Agency Information Analysis Center
General Electric—TEMPO
816 State Street
P.O. Drawer QQ
Santa Barbara, Calif. 93102

Army

Coastal Engineering Information Analysis Center
Coastal Engineering Research Center
5201 Little Falls Road N.W.
Washington, D.C. 20016

Concrete Technology Information Analysis Center
Hydraulic Engineering Information Analysis Center
Pavements and Soil Trafficability Information Analysis Center
Soil Mechanics Information Analysis Center
Army Engineer Waterways Experiment Station
P.O. Box 631
Vicksburg, Miss. 39180

Nondestructive Testing Information Analysis Center
Army Materials & Mechanics Research Center
Watertown, Mass. 02172

Plastics Technical Evaluation Center
Picatinny Arsenal, Bldg. 3401
Dover, N.J. 07801

Navy

Shock and Vibration Information Center
Naval Research Laboratory (Code 6020)
Washington, D.C. 20390

vides it to individual users. In doing so, the IACs produce critical reviews, state-of-the-art monographs, data compilations and substantive responses to queries. The principal purpose of the IACs is to provide direct, authoritative information support to the "bench level" scientists and engineers engaged in defense research and development efforts.

Currently, there are 19 information analysis centers in the DOD S&TI support system. In a further move to refine the total S&TI support system, the Director of Defense Research and Engineering, in April 1971, assigned management of nine (later reduced to eight by consolidation of the metals and ceramics centers) contractor-operated IACs to the Defense Supply Agency.

A new dimension to the S&TI functions of DSA was added with the inclusion of the DOD Information Analysis Centers in 1971. It led to identification of ways to improve DDC support of the IACs, and to a valuable interplay with scientists and engineers whose primary responsibility is to understand the information needs and problems of other S&TI producers and users. Combining the talents available within the DDC development program and the DDC information resources with the technological expertise of the IACs under the administrative and technical management of DSA and the Military Services' laboratories leads to the following potential:

- Development of S&TI systems tailored to the needs of relatively large specialty groups. DDC can develop the handling system and provide the basic information while the IACs can develop the authoritative information products and tools required in close coordination with DDC and the user. New IACs can be established to support specialty groups in specific areas of technology where advances are being aggressively pursued.
- With their capability of such varied services, the IACs have the potential to serve as studios for weekly closed-circuit transmissions of state-of-the-art documentaries, laboratory exhibits and design concept discussions in their specialized areas of competence, with the DDC serving as a computerized announcement and scheduling service.

Technical Library Function

The major part of the overall S&TI support function is the scientific and technical library within each research and development activity which, in turn, is dependent upon the centralized and specialized centers (DDC and the IACs). These libraries provide unique support to the research and development missions of their parent activities by circulating books and periodicals, performing bibliographic searches, and providing personal library services to a wide variety of specialists in their organizations.

DDC and IAC services are usually procured by the individual scientist or engineer through these libraries which thus serve as "retail stores" in the total S&TI support system. With rapidly improving support from DDC and the IACs, library staffs are turning more and more of their efforts to refining their retail services.

Producer-User Function

As an information producer as well as an information user, the scientist or engineer is the key to the effectiveness of the S&TI support system. It is the technical report of his findings, distributed to selected colleagues in his field and to DDC and the IACs for subsequent distribution to the research and development community, that makes the S&TI system work.

Thus the contribution of the individual is vital, both for the information he provides and for the feedback he gives to the S&TI system for ways to improve it.

Summary

The DOD-wide S&TI Program has evolved in the past decade into a dynamic logistical function. In a coordinated effort, it has brought about development of technical information services to defense scientists and engineers through a central storage, retrieval and distribution activity; specialized information centers in key technological areas; the services of the local technical libraries; and the input and output of individual scientists and engineers.

The interfaces between the central and specialized activities —DDC and the IACs—and between the libraries in local research and development activities and the individual producer-user constitute the logistical structure needed for effective management and execution of the defense RDT&E effort.

While considerable progress has been made toward achieving an effective S&TI logistics support system, much remains to be done. □

International Challenge Necessitates Metric Adoption

It has been nearly two years since a team at the National Bureau of Standards completed a Metric Study authorized by Congress. The work of these men and women, aided by many Federal agencies and massive participation by American industry and private organizations, is an impressive collection of the best thought available on that controversial subject of converting from our customary American system of units to the metric system.

On the basis of their 13-volume report, the Secretary of Commerce recommended the United States take positive, planned and sensible steps to bring about *voluntary* conversion to the metric system.

On Feb. 29, 1972, the Department of Commerce proposed to the Congress legislation which would create a National Metric Conversion Board to plan and coordinate a voluntary conversion process in which metric units would become the predominant, though not exclusive, language of measurement within a period of 10 years from the date of enactment. The bill was passed by the Senate but not acted upon by the House. Already in the 93rd Congress several metric conversion bills have been introduced in the House and one in the Senate.

The Metric Issue

It is important to note that metrication will proceed whether or not laws are enacted. The use of the metric system is growing apace. What is the need then for legislation? Primarily, to put planning into our current haphazard drift and, secondarily, to inform the Nation that increasing metric use is officially deemed to be in accord with the national policy and in the Nation's best interests.

What must be clear is that a conscious decision on metrication on the part of the American people is late in coming. The majority of people of the world were already using metric units before World War II. Today, the rest of the industrial nations have either made commitments to go metric or have, in fact, already converted.

What are some of the gross facts which bear on the metric issue?

by Dr. Lawrence M. Kushner
Acting Director
National Bureau of Standards
Opinions expressed herein ore those of the outhor and not necessarily those of the Deportment of Defense.

• First, whatever its relative merits, metric has won overwhelming international approval. Even in the United States, since 1893, the customary units for length and weight, the inch, yard and pound have been defined in terms of the meter and the kilogram.

• Second, everyday use of metric units is rising steadily here, as elsewhere. The pharmaceutical and roller bearing industries have gone metric. Most recently, there has developed a strong trend toward metric conversion among industries which sell finished products on the world market. School children are taught metric in math and science. Virtually all of the scientific disciplines and most engineering fields as well use metric language predominantly. A large fraction of U.S. packaged goods are dually labeled. An estimated 23 percent of the cars on our highways, including popular Detroit models, contain at least some metric parts.

• Finally, and most important, there is the changing pattern of U.S. export trade toward high technology products and services, multinational corporations, and the challenge of Europe and Japan in the international market.

The truth is that old assumptions about American technology are in serious question. The most critical and immediate problem for U.S. technology today is that the United States is losing its dominant position in the markets of the world.

Net Deficit

The challenge to the United States in the world marketplace is symbolized by a net deficit in the balance of trade. Whereas the average annual growth rate in imports exceeded the growth rate in exports only slightly in the early 1960s, by 1971 the growth rate of imports had climbed to triple the growth rate in exports. While U.S. manufacturing productivity rose 32 percent from 1960 to 1970, Japanese productivity almost tripled. While U.S. exports of manufactured goods rose 110 percent, Japanese exports quadrupled.

Improving the country's competitive position in the world markets is not a trivial task. Many things must be done. Prime among those —as pointed out by the Metric Study—is to improve effectiveness in international standards deliberations.

One mile = 1.6 kilometers
One kilometer = .6 mile

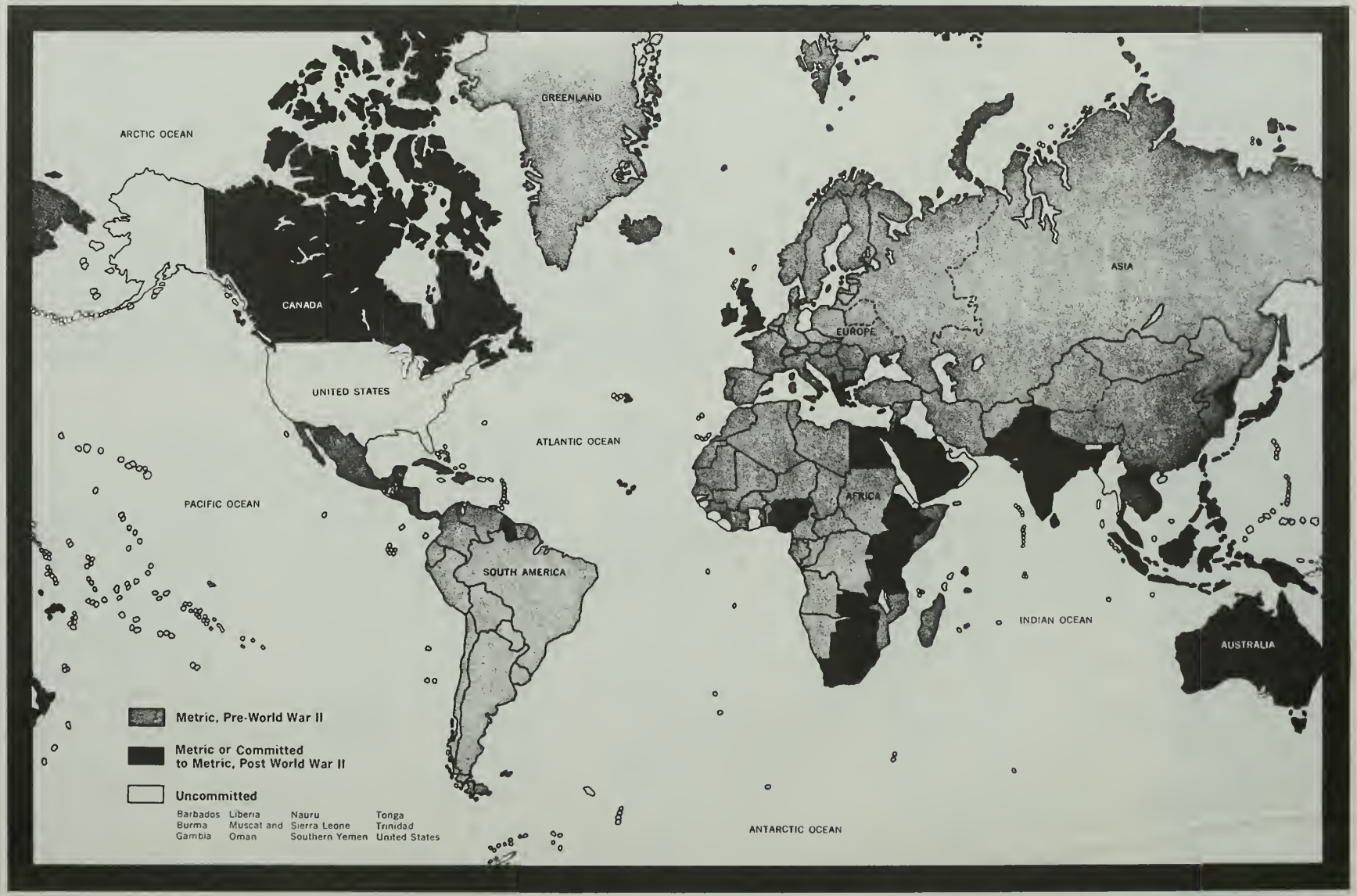
A distinction must be drawn between two facets of metrication—measurement language and engineering practice and design. The idea of changing measurement language is simple and fairly well understood. Insofar as a pounds and ounces scale can be converted to metric by changing the dial plate alone, only a language change is involved.

Engineering practices and standards are entirely different. They involve the arbitrary sizes, shapes and configurations in which we make our goods. They derive from a natural human inclination to simplify design and to prefer whole numbers. Screws, bolts and other fasteners could be made in an infinite variety of lengths. But common sense tells us that we do not need all sizes, so we standardize in a few conveniently spaced sizes and make those.

Standardization has brought great benefit to both manufacturer and consumer. At the turn of the century, light bulbs were made in an absolutely bizarre number of base sizes, threads and bulb configurations. Industry, through voluntary standardization, reduced the kinds of bulbs manufactured and thus they simplified manufacturing procedures, simplified the consumer's shopping and reduced light bulb prices dramatically.

Where U.S. industry may choose to make a

Islands in a Metric World



fitting two inches in diameter, an industry in a metric country might prefer five centimeters. The resulting parts would be tantalizingly close in size, but completely incompatible. How do we try to avoid such incompatibilities, such barriers to international trade?

Main Avenue Is International

The main avenue for nations of the world to make agreements on engineering standards is through international standards making organizations such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). In the working committees, representatives of interested nations meet to write international standards which recognize product technology used by participating countries. The resulting standards often require adjustment in national practices, but if the job is done properly no products are completely excluded and the adjustments fall evenly among the participants.

One yard = .9 meter
One meter = 1.1 yards

The United States has two handicaps in this process. First, our industries do not participate to the extent that they should and, second, our representatives take up much of their time worrying about the metric—U.S. customary unit problem. Our people must work to have measurement conversion tables included in written standards. This gets them labeled as obstructionists. And it distracts them from the main task—the consideration of technology and the protection of existing U.S. practices. Since the battle for international markets is fought to a great extent in these international standards deliberations, and will be for years to come, it would be well if our representatives could enter negotiations with no such unnecessary burdens.

Recognition Due

We have every reason to expect that U.S. technology will receive the recognition it is due if we participate vigorously in the negotiations. Today about 2,500 international standards and recommendations have been adopted by IEC and ISO. World trade needs somewhere between 20,000 and 30,000 standards to function effectively. The industrial powers of the world now recognize the urgency of this need and are producing international engineering standards at an ever increasing rate. Most of the international standards required will probably be drafted in the next 10 years.

One quart = .95 liter
One liter = 1.06 quarts

If the United States stands by while other nations write 10,000 metric industrial standards, then "going metric" in the United States will mean conversion to foreign industrial practice. If, instead, we get our technology written into those international standards, other nations will have to change to our technology at least as often as we do to theirs. This is a major source of urgency for developing national metric standards.

Harmonizing Standards

The nations of the Common Market and European Free Trade Association are trying to put together a market of 265 million people. To do this they must harmonize their measurement standards and their engineering standards. They have all agreed to speak the same measurement language and develop common engineering standards so they may exchange goods freely between nations.

In world trade, the issue of metrication is most important in "measurement-standard sensitive" (MSS) products, those in which dimensions and measurement units are critical, like thermometers, vacuum pumps, computers, refrigeration equipment, printing machinery,

One gallon = 3.8 liters
One liter = .26 gallon

etc. In 1969 the United States exported about $14 billion worth of MSS products, and imported $6 billion worth.

Differences in engineering standards are taking on a new importance because regional groups are agreeing on common quality standards and certification programs. Products certified in the manufacturing country as meeting agreed engineering standards will be accepted without further inspection or test by all other

countries adhering to the agreement. This will facilitate trade among the agreeing countries, but can inhibit imports from all others.

The urgent need now, if this potential nontariff barrier to trade is not to have major impact on our exports, is for our much greater participation in the development of international engineering standards and our access to these emerging certification programs.

A major milestone was reached in August 1972 when the Senate approved U.S. membership in the International Organization of Legal Metrology (OIML). In September, the United States became the 38th member nation of that organization. I had the honor of heading the first U.S. delegation to the International Conference.

One ounce = 28 grams
One gram = .035 ounce

OIML was founded in 1955 to promote international cooperation and harmonization on the legal aspects of measurement, *e.g.*, what measurements and measuring instruments are used in the enforcement of weights and measures laws in the marketplace. It recommends uniform international requirements for measuring instruments and works out model laws for consideration by member states.

In supporting U.S. membership, Richard Simpson, Assistant Secretary of Commerce for Science and Technology, noted that until the United States became a member, U.S. measurement technology was often ignored. "This has made it difficult to sell U.S.-made instruments abroad. The value of instruments which could be affected by OIML recommendations runs to $400 million annually—about half of the instruments sold abroad each year."

Enthusiastic Participation

If we ignore the trends and do not participate vigorously in the international standards making process, we will surely soon find ourselves at a large competitive disadvantage, whether we convert our measurement system or not. Surely the metric issue has a great deal to do with our performance in international standardization, but it is not the overriding issue.

If we participate enthusiastically in international standardization, but ignore metrication at home, we will protect and perhaps even improve our trade position in the near term. But in this case, over time, pressure to rationalize dimensions in metric units will either force conversion to metric on a product-by-product basis or will drastically increase the expense U.S. manufacturers will have to bear in keeping double inventories.

In view of these considerations, the most rational stance we can take is vigorous participation in international standardization as proponents of U.S. engineering practice, combined with a planned voluntary conversion to metric usage in this country. This is the point of view the Department of Commerce and the National Bureau of Standards have taken before the Congress. □

NATIONAL BUREAU
OF STANDARDS

Metric Conversion Course

Planning for Metric Conversion in the Electrical and Electronic Industries is the title of a jointly sponsored course to be held May 22–24 at George Washington University.

The course, co-sponsored by the University and the National Bureau of Standards, is designed to guide companies in planning for necessary changes to metric with minimal cost and inconvenience.

A wide range of topics relating to metrication will be covered and a workshop to discuss special problems posed by attendees will be included.

ANSI: Consensus Agency for Voluntary Standards

Organized in 1918, the American National Standards Institute (ANSI) is today the major clearinghouse and coordinating agency for voluntary standardization in the United States. The Institute approves a standard when it receives evidence that all national groups concerned with the development of a particular standard have been given an opportunity to cooperate in the standard's development and have reached substantial agreement on its provisions. ANSI also represents the interests of the United States in international standardization work carried out by such non-treaty organizations as the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the Pan American Standards Commission (COPANT).

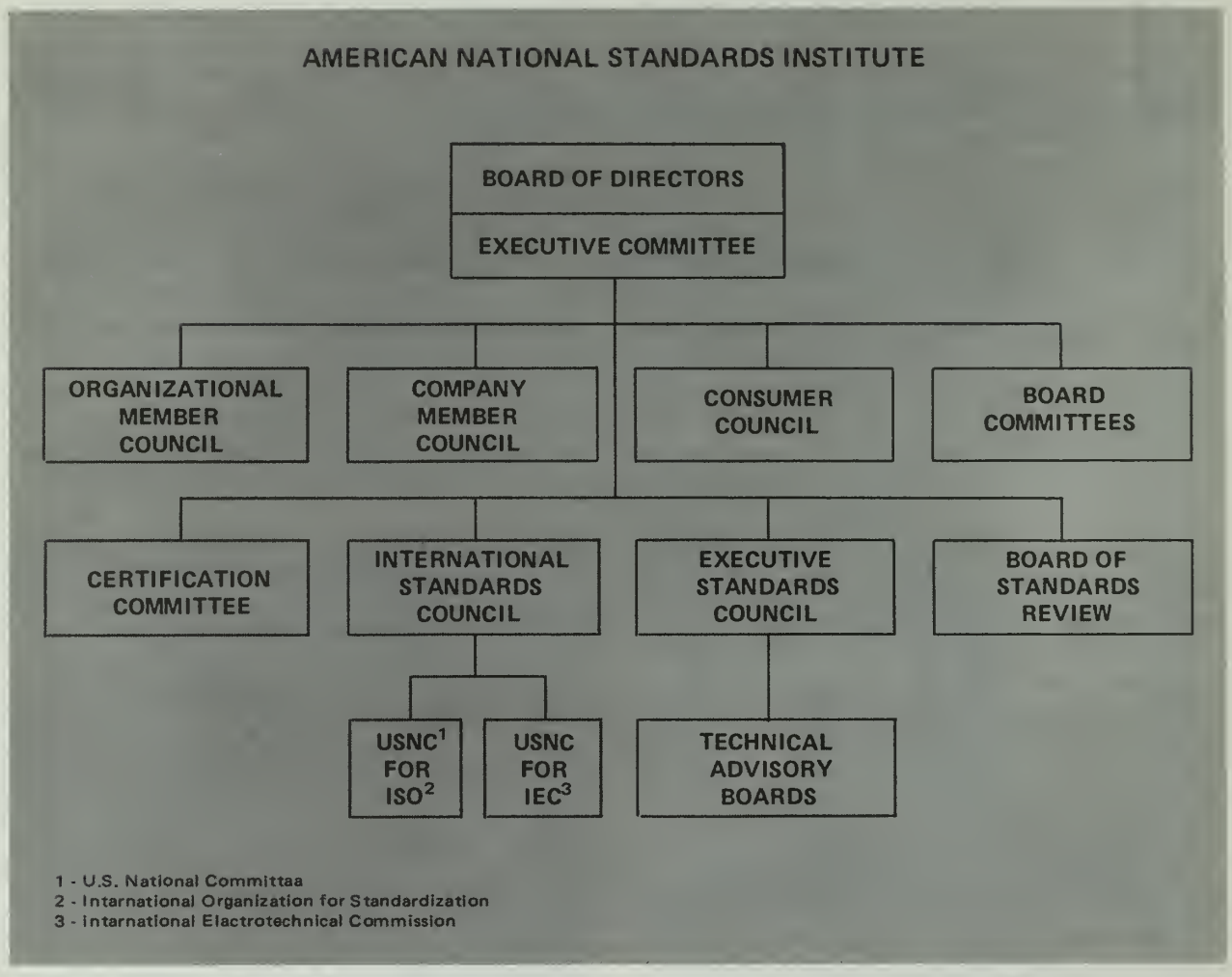
ANSI's programs are carried out through a Board of Directors, operating committees and councils, and the Board of Standards Review. The *Company Member Council* is composed of representatives of individual member companies from all sectors of commerce and industry, including manufacturing, public utilities, insurance, merchandising and transportation. The *Organizational Member Council* consists of nonprofit technical, professional, scientific, trade, labor, and other membership associations, societies, and organizations which have an interest in or actually develop standards. Ensuring that the interests of consumers are adequately represented in national and international standardization activities, the *Consumer Council* is composed of individuals representing Institute membership, consumer organizations, and other qualified groups. The *Government Liaison and Support Committee* facilitates ANSI's interaction with Government at all levels providing Federal, state and local agencies with the standards they need to fulfill their function of protecting and enhancing public well-being.

The *International Standards Council* is responsible for the international activities of the American National Standards Institute. It advises the Board of Directors concerning Institute membership in international standardization organizations, the Institute's budget requirements for international standardization, and the basic policies and procedures for participation in international standardization and certification activities.

The *Certification Committee* administers the accreditation of certification programs submitted to the Institute. Its responsibilities include fostering the development of certification programs by others in response to a demonstrated need recognized by the committee or council of the Institute. The committee also works with Government and private organizations in the development of criteria and systems for accrediting certification programs.

by Donald L. Peyton
Managing Director
American National Standards Institute

Opinions expressed herein are those of the author and not necessorily those of the Deportment of Defense.



With the exception of final approval or withdrawal of standards as American National Standards, the *Executive Standards Council* is responsible for the standards management activities of the Institute. The council is composed of six company member representatives, six organizational member representatives, four governmental member representatives, two members of the Consumer Council and three members-at-large.

The function of the *Board of Standards Review* is the adjudicative one of determining whether or not a consensus exists among those substantially concerned with the scope and provisions of a proposed American National Standard. If such a consensus is judged to exist, the board may formally approve the standard as an American National Standard. The members of the board are appointed by the president of the Institute in consultation with the chairman of the councils and with the approval of ANSI's Board of Directors. Since members of the Board of Standards Review serve as individuals and not as members or representatives of any organization, their competence and ability to render impartial judgment in the approval of standards are major criteria for appointment.

Operating Procedures

ANSI provides three basic methods for the recognition of American National Standards. In each case, interested and affected parties among the public are given ample opportunity to comment on the proposed document at various stages of development. One approach is the *canvass method*, whereby an interested group writes or commissions the writing of a proprietary standard and submits it to a ballot by knowledgeable individuals and organizations included on a canvass list. If ANSI approves the list as being sufficiently comprehensive,

these individuals and organizations vote by letter ballot on the standard. Finally, ANSI's Board of Standards Review examines the completed standard and the results of the ballot.

When the *committee method* is used, a committee representing the interests of substantially affected groups is established through ANSI with an interested organization designated as secretariat. The committee or a subcommittee writes the standard which is voted on by members of the full committee. As with the canvass method, the last step is examination by ANSI's Board of Standards Review.

Other equivalent methods may also lead to the approval of a document as an American National Standard. Organizations employing standards development procedures which meet the Institute's basic consensus principles may submit their methods to the Institute for consideration and possible approval. If such approval is forthcoming, then resultant documents may be designated American National Standards after scrutiny by ANSI's Board of Standards Review.

Each of these processes, described here in greatly simplified form, ensures that any document given the designation American National Standard is a consensus standard that has received close examination by a broad cross section of vitally concerned and affected parties. Approved standards go through final editing by the sponsoring organization or ANSI staff. They are printed, stocked and sold by ANSI and the sponsoring organization.

Diversity of Activities

The Institute's activities comprise a list that is as diverse as it is long. There are almost 5,000 American National Standards already in use, and many more are in the process of being developed. Even if a company or other group does not emphasize the use of American National Standards, it undoubtedly benefits from many of them. The consistency and performance of portland cement is covered by an American National Standard; safety requirements for elevators are based on an American National Standard, as are many data processing practices; the sizes and shapes of electrical plugs and receptacles are American National Standards; the sizes of screw threads and bolts are American National Standards.

Over the years, the close relationship between ANSI and the various Military Services has contributed to the wide success of voluntary standardization by facilitating the exchange of information and, in some cases, standards themselves. A number of American National Standards have been referenced for use as military specifications. The Y14 series of drafting guidelines is just one example. Conversely, many military specifications have been approved as American National Standards. Techniques first devised to test the shock resistance of naval equipment were adapted for wider application and published as ANSI S2.15 which describes the design, construction and operation of a Class HI shock-testing machine. Although it was originally designed to simulate severe shock conditions imposed on shipborne equipment in naval service, the machine's extended application in evaluating equipment for general military field service and transportation has indicated its usefulness as a laboratory tool for ensuring rugged, reliable equipment. More recently, military specification 105D on sampling procedures and tables for inspection by attributes was published as ANSI Z1.4–1971.

DOD Participation

Approximately 200 representatives from the Defense Department and the Coast Guard are participating in the work of the American National Standards Institute. Their expertise encompasses a broad pattern of scientific and technological disciplines. DOD participants in ANSI work have experience in areas related to research, engineering and development of Army, Navy and Air Force weapon systems and equipment, including specialized research and engineering in flight dynamics, electronics, ship engineering, underwater sound, photography, medicine, construction and civil engineering, and many other scientific and technical fields. Coast Guard personnel have participated in work on merchant marine technology and marine inspection standards.

This diversity is reflected in the Institute's general membership which comes from all sectors of society. Over and above ANSI's members, however, many more groups participate in the development of American National Standards in the interest of producing docu-

ments truly consonant with consensus principles. For instance, the recently published American National Standard S1.20–1972 on procedures for calibration of underwater electroacoustic transducers drew upon the talents of representatives from more than two dozen groups. These included the Acoustical Society of America, the American Society for Testing and Materials, the American Society of Mechanical Engineers, the National Bureau of Standards, and the National Electrical Manufacturers Association. The Departments of the Army, Navy and Air Force were likewise involved.

General Areas of Activity

With regard to the variety of the Institute's work, it would be impossible to give a complete rundown on the standards projects now underway. Still, by discussing the general areas in which the Institute is active, it is possible to convey a reasonably clear and comprehensive picture of the part which ANSI plays in the sphere of voluntary standardization.

Occupational safety and health is a prime example of how ANSI and the consensus system have mobilized their resources to provide an effective, much needed body of standards. Since the Williams-Steiger Act was passed by Congress, more than 120 American National Standards have been referenced for use by the Occupational Safety and Health Administration. Many of these documents deal with products that are necessary to maintain a safe and healthful work environment. To mention a few, there are American National Standards that cover the safety aspects of structural steel, seamless copper water tubing, aluminum-alloy seamless pipe and seamless extruded pipe, rubber insulator hoods, accident prevention signs and industrial head protection.

ANSI is also active in the area of standards for consumer products. The Standards Screening and Review Committee of ANSI's Consumer Council has reviewed and reported to the Board of Standards Review on 48 standards. In addition 15 are in the review process. The committee has established a pilot program in conjunction with American National Standards Committee Z21 on gas appliances to preview their standards during the development stage prior to submission to the Board of Standards Review. Twelve standards are being or have been previewed.

Consumer Assistance

Recently, the Institute organized a special committee to determine ways in which the consensus system can best interact with the Federal Government's new Consumer Products Safety Commission. Chaired by Dr. Melvin R. Meyerson of the National Bureau of Standards, the Consumer Product Safety Committee of the Consumer Council has launched a standards action program in consumer product areas where there are no standards or where further work seems to be in order. Letters have been sent to 20 industry groups over the signature of the Consumer Council chairman requesting action on standards development. At the urging of the Consumer Product Safety Committee, two industry programs have already been organized pertaining to safety standards for consumer products in areas where a history of injury has been confirmed. These standards involve hot surface temperatures and slipperiness of shoes.

In the field of nuclear energy, ANSI is working closely with the U.S. Atomic Energy Commission (AEC) to develop a wide variety of guidelines. A current compilation shows that a total of 323 nuclear application documents are needed and that 190 have already been approved under ANSI procedures. The work of two major ad hoc committees of ANSI's Nuclear Technical Advisory Board has resulted in the inauguration of 102 priority projects and plans for the preparation of an additional 221 standards on accelerated schedules.

AEC is actively encouraging the development of such voluntary standards in the regulatory process. To this end, ANSI and AEC have promulgated procedures whereby all approved ANSI N-designated standards are formally accepted by the AEC or explicit reasons for not using them are given. If applicable, they are used wherever possible to replace provisions of AEC Safety Guides.

International Role

On the international level, ANSI represents the interests of the United States in the International Organization for Standardization (ISO) and the International Electrotechnical

Commission (IEC). International voluntary standards are, for the most part, the result of actions by technical committees of these organizations. Such standards are fast becoming the common language by which trading nations understand each other technically, commercially and legally. Consequently, ANSI's participation in the work of ISO and IEC ensures that the case for U.S. technical and engineering practices is adequately presented in the world standards forum, an advocacy that is becoming increasingly important to maintaining the Nation's commercial posture.

In this same vein, the Institute has launched a new service titled Technical Help to Exporters (THE) in conjunction with the British Standards Institution. For a per-hour fee, ANSI will supply the latest available information concerning technical and regulatory requirements for almost any part of the globe. Based upon the results of a preliminary study, ANSI has reached an interim agreement with the British Standards Institution that will make THE's services available to interested groups in the United States. Subsequent evaluation will enable the Institute to determine the need for a more comprehensive arrangement and greater staff support.

Metric Conversion

While the United States has not yet adopted a specific metric conversion program, legislation is pending before Congress which commits the Nation to the principle of metrication. This situation prompted the ANSI to propose the establishment of an American National Metric Council at a meeting which brought together leaders from industry, Government, labor and the consumer movement. The consensus of those present was favorable to the ANSI proposal, and the Institute was instructed to develop more detailed plans for organizing and funding such a program.

The Institute's Board of Directors took positive action with regard to the basic concept and organization of the American National Metric Council on Oct. 17, 1972, when it authorized formation of the metric body. According to ANSI President Roy P. Trowbridge, the council will assist the Nation by providing a neutral forum and implementing mechanism through which metrication problems may be resolved, timing agreed upon and economic as well as technical feasibility assessed.

An initial step in a change to the metric system will be the development of a reasonably complete shelf of metric standards. Even though there are almost 200 ISO recommendations and standards incorporating *Systeme Internationale* Units which could be used as the basis of American National Standards, many more are needed. Along with its broader objectives, the American National Metric Council will help fill this standards gap and maintain the country's technical and commercial position in a world that is almost wholly metric.

As currently envisioned, the council's purpose will be one of providing planning and coordinating services to groups involved with increased metrication. It will not actually develop and coordinate a system of voluntary increased metric usage in the United States. The council will in no way substitute for or preclude national legislative action in the field of metrication. Nor will it usurp or diminish the functions of the National Metric Conversion Board described in legislation that has been put before Congress.

The council will be appointed by the American National Standards Institute and be composed of qualified representatives from industrial, labor, consumer, and Government groups. An executive committee encompassing these elements is now being organized. A supporting staff is likewise being assembled. Thus the American National Standards Institute is playing a uniquely vigorous role amid the complexities of increased metric usage in the United States. Not only is the Institute in an advantageous position to provide assistance on the national level, but it is working to harmonize such aid with the timetable necessitated by international trends as well.

Although the programs and activities previously described constitute only a partial catalog of the Institute's efforts, they represent a relatively rounded view of the place held by ANSI in the field of voluntary standardization. As it has since 1918, the American National Standards Institute is working to implement the concept that consensus guidelines are a practicable way to meet the domestic and international standards requirements of the United States. □

Considers Capital and Cost

DOD Revises Profit Policy on Contractor Investment

During the past several years, profits earned on defense contracts have been a subject of particular interest to both Congress and the public. Obviously, profits on defense contracts have been a subject of interest to the American business community for at least 196 years.

The Department of Defense has recently introduced a new procedure to determine profit objectives for certain negotiated contracts. The new approach was strongly endorsed by former Deputy Secretary of Defense Kenneth Rush in a speech delivered to a DOD procurement conference in which he stated:

"Our business economy is bottomed on the concept of profit. The companies that we do business with have a legitimate need for profits. Without this ingredient, our suppliers can't continue to work for us. There is a pressing need to attract the most efficient companies in the country to our work. These companies must be able to attract capital and good people. None of this is possible without adequate profit opportunities."

Weighted guidelines, a structured methodology to develop profit objectives on negotiated contracts, were adopted by DOD in 1964. Although attempts were made to introduce capital as a significant factor to be considered at the time a profit estimate was derived, it was concluded consideration of this factor should be deferred. As a result, profit objectives on defense contracts are based primarily on estimated costs for contract performance.

Recently, a new procedure to be selectively applied in determining pre-negotiation profit objectives was published in Defense Procurement Circular No. 107, Dec. 11, 1972. The new approach includes both costs and capital factors.

Basically, objectives of profit policy in DOD are to:

- Attract an adequate capital base to ensure an efficient, responsive industrial base for our national security.
- Reduce overall cost of weapons by encouraging industry to use modern, efficient equipment and facilities.

Evidence suggests the current cost based weighted guidelines method does not effectively accomplish these two objectives. Therefore, the new policy, considering both capital and cost, was developed.

The goal of the revised profit policy is to encourage contractors to make cost reducing investments and to equalize the opportunity for earning profits on capital among differing contractors. Weighted guidelines, as currently used, include a few factors that indirectly take into account the amount of capital used on a contract; but our goal will be more effectively accomplished by an explicit recognition of capital in the calculation of the pre-negotiation profit objective.

by Col. Bruce Benefield, USAF
Chairman, Contract Finance Committee
OASD (I&L)

Extensive Study

DOD examined a number of alternatives prior to developing this revised profit policy. A

1965 project, headed by former Assistant Secretary of the Air Force Robert Charles, examined the role of capital and, more particularly, the problem of interest allowability on Government contracts. This led to the recommendation that capital should be considered in developing pre-negotiation profit objectives.

Logistics Management Institute (LMI), in a study conducted in 1967, also emphasized the importance of a profit related to capital as an encouraging factor for contractors to invest in facilities needed for Government contract performance.

This effort was followed by the establishment of an Armed Services Procurement Regulation (ASPR) subcommittee in late 1967 directed to explore conceptual methods of relating capital to individual contracts. This committee represented the initial effort by DOD to move toward a capital base for determining profits. While this study answered a number of basic questions, it also raised several additional issues.

IAC Panel

As a result of this ASPR subcommittee report, the Industry Advisory Council (IAC) established a panel in 1968 chaired by former Assistant Secretary of Defense (Comptroller) Robert Moot to examine the proposed methodology and address many of the basic policy questions regarding subcontracted effort, leased facilities, impact of the Government's financing policy and other pertinent issues.

Resolving many of the basic methodological difficulties, the panel made its report in 1969 and proposed that DOD develop a profit policy which would consider employed capital. Because the concept had been tested on a relatively small number of contracts, the panel thought it important for DOD to obtain a wider sample of contract capital data.

In March 1970, another ASPR subcommittee was created to direct its attention to this task. Throughout 1970 and 1971, this subcommittee refined the methodology for allocating capital and, through voluntary contractor data submission, developed a capital employed data bank of 165 contracts, representing 101 contractors.

Concurrently, another Industry Advisory Council subcommittee, under the chairmanship of Dr. J. Ronald Fox, then Assistant Secretary of the Army (Installations and Logistics), conducted a study of DOD contract financing policy. Covering a number of subjects, this report highlighted the need to implement a profit on capital policy.

In July 1971, former Deputy Secretary of Defense David Packard approved the recommendations of the subcommittees' reports to move immediately toward implementation. An OSD task group was formed to recommend policy parameters and develop a thorough implementation and training plan. This group's plan was approved by Mr. Packard in December 1971.

During the first three months of 1972, several companies were solicited to launch the first test of the proposed policy in an actual negotiation environment. A number of companies responded, but only nine contractors were selected to participate. Negotiations began in March and have now been completed. Results indicate the procedures are feasible, administrative problems are minimal and the overall plan is successful.

On May 10, 1972, a draft of the proposed ASPR revision was forwarded to industry and Government agencies for review and comments. Comments were received and former Assistant Secretary of Defense (Installations and Logistics) Barry J. Shillito approved the changes to improve policy application.

Initial Application

Because it is important the profit-on-capital policy be carefully implemented, initial application will be on a controlled basis. In addition to weighted guidelines being applicable to the contract, other criteria must also be met. To restrict the number of contract actions to which the policy initially applies, contracts with estimated costs of less than $3 million have been excluded. There is an exception to the $3 million rule in that contracts valued between $500,000 and $3 million may be eligible provided the contract awards for the contractor's profit center average more than $500,000 but less than $3 million. Only production or supply contracts will be chosen to preclude the policy from being applied to contract situations where capital is not a reasonable base for evaluating profit, such as research and development or similar labor-intensive contracts. In situations where proposed engineering costs are equal to or more than 25 percent of expected total in-house costs, the concept will not be used. In addition to these criteria, several contract cate-

gories are expressly excluded from the scope of the policy.

The essential change the profit-on-capital policy entails is modifying the basis for the procurement contracting officer's pre-negotiation profit objective of considering costs and capital equally.

Concept Application

In applying the concept, the procurement contracting officer begins with information provided by the contractor. At the beginning of each contractor's fiscal year, the contractor completes forms that will develop overall operating capital and facilities capital factors for application to individual contracts. These forms will be submitted to the resident administrative contracting officer (ACO) or, in his absence, the resident auditor.

Operating capital is calculated on an historical basis and, in certain rare instances, forecast for the coming year. For example, at the beginning of the fiscal year, contractors will submit a form developing an operating capital factor for use in all contracts for the coming fiscal year. The operating capital factor might be 10 to 15 cents of operating capital per dollar of costs incurred on a cost type contract.

In a similar manner, facilities capital will be related to the allocation base used for distributing depreciation. The facilities capital factor will then be applied by the contracting officer to the contract estimates during that fiscal year to develop the contractor's capital employed. Modifications of the fixed assets allocation may be submitted when required.

Next, a capital turnover rate

Contract Capital Index Table

Capital Turnover Rate	Low (Cost Plus Fixed Fee)	Medium (Cost Plus Incentive Fee)	High (Fixed Price Incentive)	Very High (Firm Fixed Price)
1.2 & below	8.3	10.0	11.7	13.3
1.3	7.7	9.2	10.8	12.3
1.4	7.1	8.6	10.0	11.4
1.5	6.7	8.0	9.3	10.7
1.6	6.3	7.5	8.8	10.0
1.7	5.9	7.1	8.2	9.4
1.8	5.6	6.7	7.8	8.9
1.9	5.3	6.3	7.4	8.4
2.0	5.0	6.0	7.0	8.0
2.2	4.5	5.5	6.4	7.3
2.4	4.2	5.0	5.8	6.7
2.6	3.8	4.6	5.4	6.2
2.8	3.6	4.3	5.0	5.7
3.0	3.3	4.0	4.7	5.3
3.3	3.0	3.6	4.2	4.8
3.6	2.7	3.3	3.8	4.4
4.0	2.5	3.0	3.5	4.0
4.5	2.2	2.7	3.1	3.6
5.0	2.0	2.4	2.8	3.2
6.0	1.7	2.0	2.3	2.7
8.0	1.3	1.5	1.8	2.0
10.0	1.0	1.2	1.4	1.6
15.0	.7	.8	.9	1.1
20.0 & above	.5	.6	.7	.8

Figure 1

is developed by dividing the amount of capital a contractor will use to perform a contract into the total estimated contract cost.

From a table of values (Figure 1) a capital index factor is obtained. The values in the table have already been adjusted to reflect a 50-percent weight on capital.

The last step in applying the profit-on-capital policy simply involves adding the capital resources factor derived from a table to half of the pre-negotiation profit objective obtained from the weighted guidelines.

Summary

Except for *selected factors* and *special profit consideration*, an initial profit or fee objective is developed using the normal weighted guidelines method. Under the heading of *selected factors*, the *source of resources* element is disregarded. *Special profit consideration* (when applicable) shall be added to the capital adjusted profit objective.

The contract capital index factor is derived as follows:

- Amount of capital a contractor will use to perform a contract is computed.
- This amount is divided into the total estimated contract cost to develop a *capital turnover rate.*
- Using the capital turnover rate and contract type, a *contract capital index factor* (expressed as a percentage of cost) is obtained from the contract capital index table.
- Adjusted profit objective is computed by adding the contract capital index factor to 50 percent of the profit or fee objective developed using weighted guidelines.

DOD has introduced profit on contractor capital employed area very deliberately and after a great deal of forethought. This approach has been discussed with leaders in business, Government and the academic community, who feel DOD is moving in the right direction in relating profit to capital as well as to cost. The approach developed is practical, administratively feasible and one that can serve as an example for other Government agencies. □

The way to get at the nature of an institution, as of anything else that is alive, is to see how it has grown—A. G. Keller

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Office of Consumer Affairs

Standards: Key to Consumer Protection

Standardization has been the thrust of many consumer initiatives of the past decade. Government at all levels—Federal, state and local—has responded with new laws and regulations to standardize product performance or quality, safety features and consumer information.

Mandatory standardization brings multiple benefits to the consumer. It provides assurance a product or a service meets at least certain minimum specifications. Standards govern such everyday matters as the percentage of strawberries in strawberry jam and the vitamin content of enriched bread.

Standardization often assists the consumer in comparing competing products. Laws requiring disclosure of quantity on a package, for example, enable the consumer to compare prices per quart, ounce, or square foot. Consumer comparisons are also aided by standardization of the form in which consumer information is presented. Although a consumer law such as the Truth-in-Lending Act of 1968 is not generally described in terms of standardization that is, in fact, what the law achieved. It prescribes that rates and terms of consumer credit must now be stated in a standardized form, thus revealing to the consumer the true costs of credit alternatives.

Standardization can also provide an assurance of safety. The 1972 Consumer Product Safety Act, authorizing the Government to set safety standards whenever there is a demonstrated need, adds a new dimension to the consumer movement's drive for standardization to achieve safety. In earlier legislation consumers sought Federal safety standards on a product-by-product basis through laws such as those on automobile safety, toy safety and fabric flammability.

Voluntary Industry Programs

Consumers also benefit from voluntary industry programs to standardize products and services. The Office of Consumer Affairs (OCA) has sought to encourage the development of voluntary industry standards to satisfy a wide variety of consumer needs. There has been considerable progress the past few years.

Appliance manufacturers, aware of legislation proposed by the Administration and members of Congress to require explicit standardized disclosure of the terms of warranties, have greatly improved the clarity of their warranties on a voluntary basis. The appliance industry is also developing standardized information stickers or tags to inform consumers of some product characteristics such as the

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Opinions expressed herein are those of the author and not necessarily those of the Department of Defense.

capacity of a refrigerator or the load of a washing machine.

Some voluntary standardization programs build in a form of enforcement such as certification. Underwriters' Laboratories, for example, permits its seal to be affixed only to those products that meet its safety standards for electrical systems. The use of the UL seal is a selling point.

Many supermarkets have adopted new labeling schemes so previously coded dates on perishable products are now easily read by consumers. Many have also adopted unit pricing, marking supermarket items with the price per pound, quart, or other measure in addition to the price per can or box.

A critical difference between voluntary and mandatory standardization lies in the incentive to meet the standard. An informal survey of the implementation of unit pricing systems, conducted by OCA, revealed some supermarkets fail to keep all unit pricing tags up to date and legible, or do not adequately educate the consumer on how to use unit pricing.

Voluntary safety standards arrived at by industry consensus can help to facilitate the transition for an industry if the Government adopts mandatory standards. When an industry consensus exists on a standard, it is often recognized in the development of laws and regulations. The Consumer Product Safety Act, for example, explicitly requires that industry standards be considered when new product safety regulations are developed.

Standards for Automobile Repair

Mandatory and voluntary standardization each has its place in contributing to protection of the consumer. One of the biggest trouble spots for today's consumers is in the area of automobile repair in which both mandatory and voluntary standards are largely lacking. Neither the qualifications of mechanics nor the equipment and facilities required to accomplish needed repairs are standardized. Nor are there standards for what constitutes quality repair work. As a result, the consumer has no objective measure by which to choose a repair shop and no assurance the shop he chooses will do work that meets even minimum standards.

When consumers seek automobile repairs they feel vulnerable and are distressed by the difficulties they encounter in getting their automobiles serviced. The Office of Consumer Affairs receives two to three times as many complaints from consumers about automobiles as about any other consumer problem, and most of the complaints on automobiles are about servicing.

A recent survey of state consumer offices, conducted by OCA, showed that automobile repair service was a major source of complaints at the state level, too. Workmanship, either shoddy work or the failure to perform work, was the most frequently received complaint.

Assessing Quality of Service

The automobile industry itself is hampered by the lack of objective servicing standards.

Virginia Knauer observes work being accomplished at automotive repair facility.

How can a complaint processor verify the validity of a consumer grievance or an allegation of poor quality automobile service when service standards have not yet been defined? Conversely, a company which wishes to recognize a service center's effort to provide superior service is limited by the lack of industry standards for measuring performance.

As Government agencies are asked to become involved in automobile servicing problems, either through regulation (as is now the case in California) or in response to individual complaints, they too are limited by the lack of standards.

As the need for standards gains acceptance, so does the recognition that in setting standards care must be exercised not to freeze outmoded procedures in place nor limit the professional judgment of mechanics. It is also important not to create barriers that would unduly restrict entry into the automobile repair business.

Both voluntary and mandatory routes to improved automobile servicing standardization are now being thoroughly explored.

Recognition Program

In October 1971, the Office of Consumer Affairs presented a proposal for a voluntary quality service recognition program to each of the four major American automobile manufacturers. The program, as proposed, included a public rating of service capability and performance that would incorporate both standards and consumer comments. Although manufacturers are generally aware of the quality of the service offered by a particular dealer, consumers have not had access to such information nor were their views on service quality sought by the manufacturers.

A rating system that incorporates consumer comments, compiling good and bad customer experiences, would be useful to consumers and could also help industry in developing comprehensive service standards. Consumer comments could be solicited by distributing post cards to the consumer at the time of servicing to be returned directly to the manufacturer.

To be fair to the dealer, a rating system should also include evaluation by an independent panel of experts set up, but not controlled, by the manufacturer. The panel would inspect dealer service shops for the adequacy of their facilities and equipment. Standards for facilities, equipment and mechanic competence are implicit in such a scheme.

Manufacturer Incentives

As part of its proposal, the Office of Consumer Affairs also urged automobile manufacturers to provide incentives to dealers to improve the quality of service which too often has been regarded as the stepchild of a dealership. There is a great need for industry incentives that give the mechanic status and create rewards for good service, similar to those now provided for sales performance.

The kernels of the OCA's proposals were incorporated by Ford Motor Co. in its new "No Unhappy Owners" program announced last summer. Ford is actively soliciting consumer evaluations of the service provided by its dealers.

Ford's program also includes new incentives for mechanics who now sign their names to the work they do and make follow-up calls to customers. There are contests and awards for outstanding mechanics.

Certification of Individual Shops

The automobile industry as a whole is also working on the development of standards that will reach far beyond individual company dealerships and can help to provide consumers with a measure of the competence and adequacy of any participating shop, including independent ones. The National Automobile Dealers Association and the Motor Vehicle Manufacturers Association last year jointly established the National Institute for Automotive Service Excellence. Its first program is to provide for individual certification of automobile mechanics' competence through a system of voluntary tests.

Certification is a welcome first step, but the program still contains several pitfalls for the consumer seeking assurance a repair shop meets standards for quality work. Certification is not a measure of a mechanic's honesty and there are no provisions for revoking a mechanic's certification for fraud.

So far the Institute has focused only on the problem of setting standards for mechanics' qualifications. However, the Institute recently

established a Facilities and Equipment Committee to address the need for standards in these areas and is also considering the development of standards for the quality of repair and service work.

Standards at State Level

Individual states are also taking actions that will hasten the movement towards the establishment of standards. In 1971 California enacted the Nation's most comprehensive automobile repair shop licensing law. The act provides for revoking a repair shop's license for "willful departure from or disregard of accepted trade standards for good and workmanlike repair." Although the California statute does not set standards, the act begs the question of what accepted trade standards should be. Setting those standards is the next logical step.

Many states are watching California's experience with its licensing law. The survey conducted by the Office of Consumer Affairs showed that legislation to provide some additional regulation of automobile repair was introduced in many states last year. The most frequent state proposal was auto repair dealer licensing. The second most common proposal was to license both dealers and mechanics.

Consumer pressure for both mandatory and voluntary action on automobile servicing is moving the repair industry toward standardization which appears to offer the best avenue for improvement in this area of consumer concern. Even when consumers do not explicitly call for standardization, their demands for ratings, certification and licensing assume there are standards by which repair services and facilities can be judged. The growing number of voluntary and mandatory efforts to improve the quality of automobile servicing will create standards that enable the consumer to judge service quality. □

Nuts 'n Bolts

(continued from page 27)

circuits, however, will have their most significant impact downstream and should benefit DOD logistics for other new defense systems.

• *Connectors.* F–15 connector families (series) show a two-thirds reduction over the number of different connector families used on F–4E aircraft. This significantly reduces the different tooling and processes required by contractors, customer, field operations and logistics activities. Also, the F–15 uses only 315 connector types compared to 410 types used on the F–4E, a 25-percent reduction.

• *Fasteners.* Only 1,200 fastener types are used in the F–15 compared to over 2,800 types used in the F–4, a reduction of over 50 percent.

• *Quality/Performance.* Although the F–15s have not yet accumulated statistically significant substantiating flight and environmental test data, laboratory test data to date shows a significant improvement in equipment performance, even exceeding an order of magnitude for some equipments.

Thus, the F–15 Parts Control Program results to date indicate the achievement of significant improvements in quality, performance and standardization—all attributed to a more cost conscious and cost effective parts standardization management. □

Controls Begin at Home in Design to Cost Contracting

Design to production cost, in many respects, represents a new challenge to the defense industries and is expected to be a way of life in the future in the design and production of major defense systems.

For the first time in U.S. Army helicopter procurement history, the objective of designing a major defense system to fit within the framework of a predetermined production selling price has been set forth as a contract design parameter in the basic engineering development phase of the Army Utility Tactical Transport Aircraft System (UTTAS) program, and a substantial financial incentive has been assigned to this objective.

A design to cost clause has been included in the special provisions of the contract to put teeth in this requirement.

In writing such a clause to be included in a contract, many things must be evaluated to properly tailor a clause to the customer's requirement. For example, the cost objective expressed in dollars must be described in such a manner that final results can be evaluated against the objective. One method of doing this is to express the objective in terms of current dollars and provide a formula in the contract to adjust for inflation or other price level changes that may take place from the date of the agreement to the dates involved for actual delivery of the product.

From a contractor's point of view, he must consider many variables before agreeing to contract terms and language. It would obviously be advantageous to the contractor to have a design to cost clause that would not be invalidated by either inflation or adverse changes in business volume. This could be readily achieved by establishing agreed upon negotiated labor rates and overhead rates for the base period and converting back from the actual results to these negotiated labor rates and overhead rates.

This would also work to the advantage of the Government when business volume in the forward period turned out to be greater than that involved in the base period. It would result in a design to cost objective expressed in terms of direct labor hours, engineering hours and material costs adjusted for some applicable index which properly reflects the price trend in aeronautical materials. Although this is an ideal manner of expressing the conversion of future experience back to a base period, it is not the method used in the UTTAS contract.

by Paul W. Holt
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Opinions expressed herein are those of the author and not necessarily those of the Department of Defense.

Follow-on Production

In addition to the problem of establishing a proper base period and a method for converting the actual experience back to the base period, it is also necessary to give consideration to the anticipated volume in the follow-on production contracts and the timing of this volume. If the production program as projected fails to materialize, there is the need of providing some protection to both the Government and the contractor to avoid undue penalties or the payment of unearned incentives. A formula can be worked out to cover possible variations in schedule or quantity which impacts on the average airframe price, or it may be simply provided in the contract that an equitable adjustment in the cost objective will be made for any change in quantity or schedule which impacts on the average end item price.

It is also necessary that the cost objective be subject to adjustment for changes in the definition of the end item. Considerable skill is required on the part of both the contractor and the Government to make proper adjustments to the cost objective to properly reflect all changes in the work.

Now that the design to cost concept has been included in contracts along with performance and other design parameters, trade-off studies will be necessary between production selling price and other design parameters, such as weight empty, speed and agility. In order to make such trade-off studies, cost values will need to be established for some of these other design parameters. Such trade-off studies should be carefully coordinated between the Government and the contractor.

Cost Value Objective

In the case of the UTTAS contracts, the Government has, in effect, already assigned a cost value to the design to cost objective by including incentive provisions in the contract to provide a ready standard for achievement in this area. If the contractor meets all other design parameters of the aircraft, the measure of his reward or penalty can be readily calculated in accordance with the formula provided in the contract. However, there is the possibility that a contractor may meet the design to cost objective with an agreed upon adjustment in some other parameter such as engine fuel consumption or cruise speed. In the interest of good contract administration, any trade-off that results in a failure to meet some other design parameter should be negotiated at the time of the occurrence of such a decision to avoid an unnecessary argument at a later date.

UTTAS Model

The actual mechanics of handling some of these contractual problems in the UTTAS contract are of interest. The target, design to unit production cost, is referred to as the average recurring airframe cost for the program. In order that there be no misunderstanding of recurring costs, it is desirable to quote directly from the contract in order to obtain the proper understanding of this term:

> *"The airframe recurring cost includes recurring engineering direct labor and applicable engineering overhead, manufacturing direct labor and applicable manufacturing overhead, general and administrative overhead, material and profit on recurring costs only, associated with production and includes the cost for installation of Government-furnished equipment such as engines, avionics and weapons. Nonrecurring costs such as tooling, nonrecurring engineering, and total costs of kits, GSE, GFE and data are excluded."*

The prime contractor will be evaluated on the basis of an initial production contract to be signed by the prime contractor prior to a commitment on the part of the Government for the actual procurement.

The actual method dealing with changes in

the price level as expressed in the UTTAS contracts is as follows:

"The constant objective (constant FY 1972 dollars) will be adjusted to current year dollars by using the Implicit Price Deflator for the Total Gross National Product (index base 1958 = 100) published by the Department of Commerce, Bureau of Economic Analysis as reported periodically in the United States Department of Commerce publication entitled 'Business Conditions Digest.' The latest available 5-year average rate of increase will be applied from 31 December 1971 to the mid-point of effort under the first production contract."

Average Index Increase

From 1958 through 1970, the average increase in this index has been 2.6 percent a year. If this is the average experience as measured by the five-year period referred to in the contract, this will mean that the actual selling price for the first quantity of aircraft will be greater than the objective for this quantity.

It is, of course, obvious that individual contractors may experience inflation at a higher rate than that reflected by the index and that the conversion from actual selling price back to the target price is based on the rules established by the Army which may not coincide with actual cost increases experienced by the supplier from FY 1972 through the contract period. This, of course, means that any increase in labor cost or material costs in excess of the average annual change in the gross national price deflator must be offset by increases in productivity or other changes in the cost structure of the supplier. It should be noted the Army picked the implicit price deflator as the means of adjusting back to FY 1972 dollars in lieu of actual experience by an individual contractor or actual experience of the aircraft industry as a whole. The gross national price deflator actually includes an adjustment of substantial proportion each year for increased productivity. For example, if inflation should occur at the rate of 6 percent in a given year and productivity increases 3.5 percent, the deflator would show an increase in the index of only 2.5 percent.

As the design to cost clauses included in the UTTAS contracts represented a first attempt to implement the new procurement philosophy, there are bound to be many variations in the future aimed at achieving the objective of providing an adequate quantity of essential weapons within the framework of a limited budget.

Different Cost Approach

The RFP for the Advanced Attack Helicopter (AAH) has now been released to industry with a design to production cost provision which approaches the problem in a different manner than that used by the Army under the UTTAS contracts.

The first major difference in the RFP for the AAH is a different makeup of the cost objective. Whereas the contract cost objective as expressed in the UTTAS contracts covered only the nonrecurring cost under the control of the particular contractor, the cost objective for the AAH includes all Government furnished material (GFM). With the introduction of this new element into the objective, the prime contractor for the air vehicle is bound to have a new interest in the selection of GFM. In fact, it is possible that the final outcome of the fee adjustment resulting from the design to production cost clause may be substantially influenced by the selection of GFM. It is also possible this selection may be beyond the control of the prime contractor for the air vehicle.

Incentive Differences

Another outstanding difference between the UTTAS contracts and the RFP for the AAH in the design to cost area is that the incentive provided to the contractor is in the form of an award fee under the RFP for the AAH, whereas the UTTAS contracts provided a definitive formula for the computation of a positive incentive fee or penalty for the design to cost objective.

It is, of course, true that the penalty for failure to meet the design to cost objective could be very substantial under the UTTAS contracts. The award fee concept does away with the considerable risk which was assumed by the contractors under the UTTAS contracts. The award fee to be determined solely by the

Government could be a very substantial amount and could provide a very substantial incentive towards meeting the design to production cost objective.

However, in the establishment of this clause in the RFP for the AAH, the Government has taken on the entire responsibility of making the determination of performance in the face of many variables, without informing prospective contractors of the contemplated methods of dealing with these variables. Contractors, by nature, are sometimes skeptical of contract provisions which depend entirely on subjective judgments in which they are not allowed to participate and would prefer more advanced knowledge of the intentions of the customer.

Meeting the Design Objective

Now that the subject of a design to cost contract clause has been discussed, it is desirable to review some of the things that can be done to meet this design objective.

Defense contractors have learned from experience that proper coordination between design and producing departments at an early stage of the game is helpful in providing the cross-feed of information that is necessary to meet the objective. Accordingly, it is necessary from the beginning to have talented people from the manufacturing, tooling and purchasing departments working with the designers. If the part or assembly is to be procured on the outside, careful consideration should be given to the possible source of the procurement and the availability of processes and equipment required to produce the part. If the part is to be made in-house, it should be designed to be compatible with the available in-house equipment and facilities.

Care should be given by the designers and the manufacturing representatives to reach agreement on the sequence of operations and procedures for assembly prior to completion of the design activity. Wherever possible, standard hardware and standard parts should be called out in the design. A minimum variation in rivet sizes, thread types and electrical connectors should be an objective. Obviously, parts that are easy to fabricate and simple to assemble will assist materially in achieving the design objective. Tolerances on noncritical parts should be opened up to avoid unnecessary rejections. Simplified means for maintaining quality standards should be an objective during the design phase.

More specifically, the positive control of product costs involves four major activities:

- Design to Cost.
- Tool to Cost.
- Purchase to Cost.
- Manufacture to Cost.

Design to Cost

Design to cost activities provide a positive means of controlling product costs generated by the design activity. Heavy emphasis is placed on cost targeting and cost visibility in the design phase in recognition of design's heavy impact on total product cost. Designers not only generate design costs but their designs also impact on tooling, purchasing and manufacturing costs. Sikorsky's Purchasing and Manufacturing Departments are most heavily affected by the designs they are required to purchase and fabricate. Since design is controlled by the Engineering Department, designs must be capable of being purchased and fabricated within specified targets. Therefore, purchasing and manufacturing targets are established as a part of basic design data and design is made responsible for meeting these targets. These targets are imposed on designers as part of basic data as are other attributes such as reliability, weight, safety, etc. It is the responsibility of designers to meet the targets, but assistance is provided by a program producibility team consisting of specialists representing the departments shown in Figure 1 (see next page).

As design progresses, estimated costs and the basic labor and material content of specific designs are calculated and compared to target cost to identify variances requiring corrective action. Designers call upon the producibility team for guidance in reducing the cost of their designs.

Tool to Cost

Tool to cost operates in two distinct areas. First, the type and extent of tooling planned must be communicated to designers during the design phase as a factor in trade-off studies of alternative design approaches. Therefore, tool-

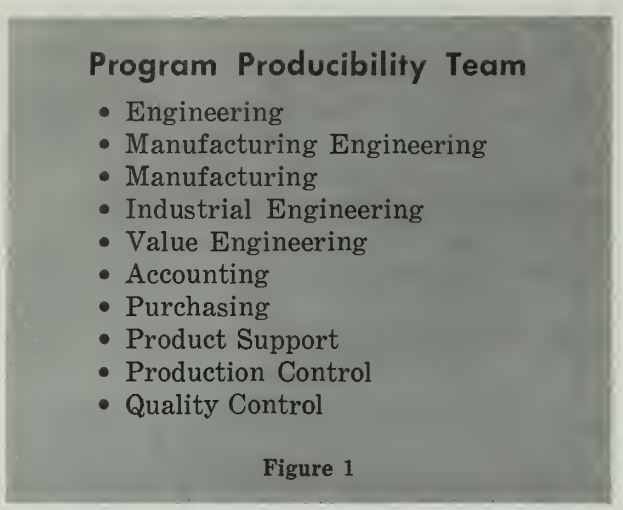


Figure 1

ing options and costs are developed by the Manufacturing Engineering specialists on the program producibility team. Design approaches ultimately selected represent the balancing of product and tooling cost based upon production rate and the quantity to be produced.

The second control function begins at the conclusion of the design phase. Product cost estimates of designs become targets for Manufacturing in the prototype and production phases. The Manufacturing Department's ability to meet the prototype and production targets depends heavily on the Manufacturing Engineering Department's performance in providing the required prototype and production tooling. If Manufacturing Engineering does not provide, on schedule, tooling equal to or better than that on which the prototype and production targets were based, Manufacturing will not be in a position to meet its targets. Consequently, as tooling is planned, estimates of corresponding manufacturing cost are developed and compared to target costs. Significant variances are referred to Manufacturing Engineering for corrective action. Manufacturing engineers call upon the producibility team for assistance in meeting target costs.

Purchase to Cost

Purchase to cost also operates in two distinct areas. First, interaction between designers, buyers and vendors or subcontractors is necessary to enable the selection of minimum cost purchased parts and proprietary items. Conferences between designers and vendors are arranged by the Purchasing specialists, and guidance in evaluating cost quotations is provided through the development of estimates of the labor and material content of purchased products.

The second control function is based upon the source established as a result of bids obtained during the course of a purchasing/engineering project cycle. Cost quotations are used to establish targets for the Purchasing function. Buyers call upon the program producibility team for assistance in meeting target costs.

Manufacture to Cost

Cost estimates developed by program producibility team specialists are issued to Manufacturing as targets for production. Manufacturing performance is monitored to identify significant variances for corrective action. Manufacturing calls upon the producibility team for assistance in meeting target cost.

Control of Overhead Cost

In addition to our concern with direct production costs, it is also mandatory, if we are to obtain our objectives, that the prime contractor and the first tier subcontractors pay proper attention to the control of overhead costs. In the aircraft industry at the present time more than two-thirds of the purchase price paid by the Government for major defense systems consists of overhead cost incurred by the prime contractor and the first tier subcontractors. With overhead representing such a large portion of the total, we must control overhead cost. We have recognized the need of this control and we have taken many positive steps to reduce overhead and to control overhead costs.

The most significant step has been the establishment of a strong budget control system.

Budget reports of actual versus budget are prepared each period from the computer by Management Information Systems. These are reviewed each period by the Business Analysis Office, the department manager and the division president.

Summary

Cost effectiveness is built into products through the systematized application of posi-

tive cost controls from initial design through production. Heavy emphasis is placed on the design phase in recognition of the fact that cost avoidance in the design phase has the greatest impact on total product cost. Considerable effort is expended by designers to optimize their designs from a cost standpoint through direct interaction with a team of producibility and cost specialists.

After designs are finalized, estimates of basic labor and material content are used as targets for Manufacturing, Engineering, Purchasing and Production. Through the application of this cost control discipline, the contractor designs to cost, tools to cost, purchases to cost and manufactures to cost. The result is to respond in a positive manner to the customer's need. □

There is no royal road to anything. One thing at a time, all things in succession. That which grows fast withers as rapidly; that which grows slowly endures.

—Josiah Gilbert Holland

Design to Cost

Reducing Costs Can Be Fun: Judgment, Flexibility Needed

Defense was the dominant factor in public spending in the 1950s. Now other requirements, both Federal and local, have a far greater impact upon the economy but are less controversial and less visible. Although controversy and visibility have often been frustrating and painful, they have also been healthful in the sense of forcing continued effort to improve our cost management techniques. The introduction of these new techniques has not always resulted in improved management. A great deal of progress has been made, however, in the development of systems that capable managers can use; and the combination of tough, competent management and useful management tools is resulting in good cost performance on many difficult programs.

The work of the past few years leading to more prototype procurement and the recent efforts to apply "design to cost" principles to the development of complex systems offer opportunities for further improvement in the management of defense spending. I want to introduce a few notes of caution, however, which I hope will be helpful in avoiding some of the mistakes we have made implementing cost improvement techniques in the past.

by T. A. Wilson
Chairman of the Board and
Chief Executive Officer
The Boeing Co.

Opinions expressed herein are those of the author and not necessarily those of the Department of Defense.

Notes of Caution

Weapon system history is full of procurement and management fixes designed to overcome cost problems of major significance. The usual sequence includes invention of a buzz phrase to describe the fix and then almost everyone climbs on the bandwagon.

Implementation has usually been protracted and painful.

Results range from disaster to gradual evolution of some very useful systems that are helping to control costs and to enable survival in the fishbowl visibility of defense spending.

Costs can be a principal design parameter. I am sure that after a few frustrating experiences, the design to cost technique will become a valuable tool which we will learn to apply to the right development programs and to man-

age with common sense. In a few years, we will see the beneficial effects in acquisition cost. However, it will be many more years before any effects are apparent in the two great users of money—manpower and operation and maintenance (O&M).

These areas will require a radical change in thinking *and* in some ideas for exploration but, first, I'd better cover in a more direct fashion the subject of acquisition costs.

The "Good Old Days"

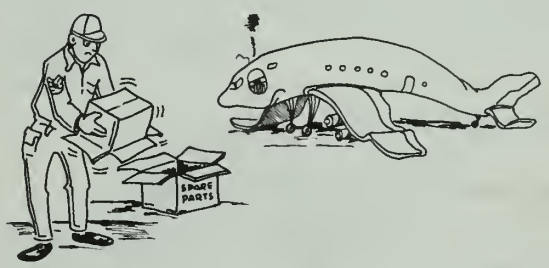
In the late 1940s and early 1950s, airplane systems were procured under what today would probably be called a production prototype philosophy. Preliminary engineering and tests were followed by a few X model prototypes, perhaps a service test quantity and then limited production. Each year's funding was dependent upon satisfactory performance during the preceding phase. Although program acquisition costs usually exceeded initial estimates, it was primarily because of lack of precise early definition. The development program was deliberately left open-ended (using production funds) to provide flexibility to cope with changing threats and to take advantage of the availability of improved technology such as better engines or better avionics systems.

This incremental development provided a sound basis for economical production of larger quantities or provided the Government plenty of opportunity to cancel at minimum cost if insurmountable technical or funding problems arose. Although this period is often referred to as the "good old days," these days were not without major problems—problems which I believe were the genesis of many of the cost management solutions which have taken us so long to assimilate.

The first problem was lack of weapon system appreciation. Flight development concentrated upon aerodynamics, propulsion and structure. Combat systems were added later so that performance penalties were often underestimated and delivery of a complete weapon system to the user was delayed. The impacts upon manpower, O&M and acquisition costs are obvious.

The second major problem was inadequate reliability. Much of this was related to technology. We didn't know very much about the acoustical effects of jet engines on secondary structure or the fatigue effects of low altitude, high speed flight on primary structure. Really complex avionics systems were relatively new and used vacuum tube technology. The impacts upon the biggest users of money are well known. It is simply amazing that the effective longevity of several of these systems has extended over periods of 15 to 20 years.

The third major problem was lack of thorough and timely development of logistics support systems. Maintainability was often an afterthought, secondary to airplane and combat systems performance. Spares, handbooks, training equipment and training programs were funded, developed and delivered late. Operational capability just sort of evolved.



All three of these problems were significant cost items. However, the cost aspects were overshadowed by operational capability and readiness impacts.

Analysis Overkill

Overcorrecting for the operational deficiencies of the 1950s caused many of the woes of the 1960s. The "-ilities" staffs of Government and industry were expanded enormously. Tons of analyses were made prior to definition of specifications—before significant design and test data were available—and these analyses were continued for years after the system reached operational maturity.

Paper analyses also substituted for production prototype developmental processes. This was to be sure we understood *all* the threats and *all* the technical solutions and *all* the development, production and O&M problems. Since these analyses made us so smart, concurrency was invented to make up for the loss of time. When cost overrun became a national concern, total package procurement was invented to force the Military Service and industry to con-

sider the "whole thing" and to inhibit contractor "buy in."

When this had less than desired effects, the accountants came in to solve all technical and management problems by having our work planned from contract award to program phase-out in exquisite work package detail and cost breakdowns to the tenth of a man.

You all know the results. After some painful misapplications, experience and common sense helped develop some very useful techniques, with about the right amount of detail at about the right time and performed as an in-line function by the right people rather than on the side by a large group of cultists. We still have a way to go. We still get an occasional program that applies too much effort before we are smart enough for it to be useful. However, our technical and management capabilities *have* improved and our cost performance reflects this.

Judgment in Applying Design to Cost

We must make sure that design to cost does not head down this same path of overkill that would create another cult before evolving into what can be a powerful and useful management technique.

There is already evidence to suggest this technique will be applied to advanced prototype programs where technical research and feasibility are the objectives. There may be segments of such advanced developments where application is proper but our past experience indicates that the advocates of new techniques will insist upon across-the-board, in-depth applications. This could be counter productive and defeat prototype objectives.

I expect even more implementation problems will be encountered in production prototype programs where design to cost parameters are certainly proper. The papers which have been written to describe how to work a design to cost problem usually cite an example which requires production of one million articles at a rate of 500 per hour or something similar. Cost objectives are then broken down to the ball in each bearing. Obviously this could apply to some military procurements, but Government and industry involved in development of complex new systems must see that such parameters are applied at a level and at a time when the state of our knowledge of requirements and solutions enables intelligent and useful application, and we must insist upon enough flexibility to accommodate changes as well as improvements in the design to cost system itself as we get more experience using the techniques.

In my opinion, it will take attention at very high levels in DOD and the Military Services to inhibit misapplication and overzealous application during the first few years of use. This will probably require review before release of the request for proposal, at contract award time and, periodically, before full production go-ahead. A few powerful people who understand the objectives will quickly accomplish more toward developing sound design to cost techniques, which can be absorbed by our normal in-line management process, than all the staffs that can be mobilized to overwhelm the problem.

Reducing Costs Can Be Fun

There are a number of companies which have done some excellent work in the design to cost field. I believe Boeing is one of these companies. The application of design to cost principles, which is a well established technique in high rate production industries, to the development of complex defense systems requires some fundamental changes in thinking as well as some imaginative work by a team of designers, manufacturing, quality, procurement and finance people. Before significant results can be expected, a cost and profit conscious environment must be developed throughout the entire organization. One program team cannot be expected to excel in cost performance if another team is allowed to retain its fat or use techniques which are archaic and inefficient. This applies at all levels of command, including corporate structures.

A very new organization, which has never built up the institutionalized hierarchies and functional checks and balances, will not achieve major improvements by belt-tightening or sharpening its management tools, or even inventing a new technique. These things, of course, must be accomplished and must be accomplished well. However, when survival is the issue, fundamental changes in operating

methods and elimination of functions must be considered. To do this intelligently, every manager needs complete visibility of his costs—an accounting system with maximum discreteness of both direct and indirect charges—and maximum authority to buy or reject the service being charged. The system must be real, with the benefits of a team's cost management skill passed on to its customer as a lower price or reflected in higher profits, or both. And last, but by no means least, a formal performance measurement system must be set up between a manager and his boss so that he knows the basis for his promotions. This can be a simple one-page contract of both quantitative and subjective items, but it helps to write it down and discuss the items before the fact and then reward commensurate with performance. Reducing costs can be fun. Once the designers and others realize this, they become highly motivated.

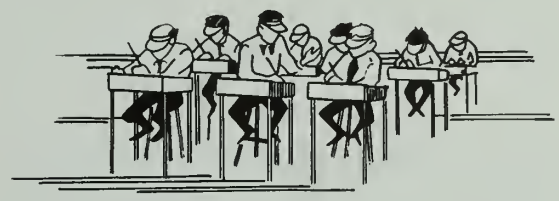
After responsibility and authority have been driven down to the lowest practical levels, the cost of every function challenged and functions that don't pay their way eliminated, the proper competitive environment necessary to achieve maximum benefit from a design to cost technology will probably have been created.

People in the organization should now be cost and profit oriented. They should have an accounting system that lets them understand their total costs. Now the engineering and manufacturing people have the tools to make the trades among various designs, various processes and the cost of labor versus capital required for automation. They can work with the quality and test people to discreetly trade the cost of disruptions for inspection or test versus the cost of buying or developing new equipment or techniques which will enable in-line inspection or test. They become very conscious of the cost of peaks and valleys of activity. They increase manpower at a slower rate and reduce it quickly, and vigorously work the problem of using the fewest possible high-skill/high-rate people. In developmental programs with reasonable schedule slack, each test is planned to get the most data for the lowest cost. In general, fewer tests will be called out; however, the team knows intimately what it costs to provide additional articles for schedule or mission confidence.

Data Deficiencies

The results of this approach are evident in current performance of both commercial and defense programs. However, there is a serious deficiency in our ability during the developmental phase to work life cycle costs. Our work in O&M is for all practical purposes limited to specification compliance with reliability and maintainability requirements plus optimization of integrated logistics support specified requirements. I believe we have done as well as anyone in this but there is really not a good basis for working design to cost with a realistic consideration of life cycle influence. As I have heard so many Government people deplore—the accounting system simply does not provide adequate data for this purpose.

My experience in dealing with Government certainly indicates there is no shortage of



accountants and although most of us in industry have gone through the process to make our cost management systems acceptable, I really don't expect those staffs to diminish. So there should be a surplus capability available to enable development of Government accounting systems which would provide useful data for the life cycle parameters necessary to maximize design to cost benefits.

Change Military Service Concepts

I indicated earlier that, even with rapid development of effective design to cost techniques, it would be many years before substantial impacts were made upon the two greatest users of military funds—manpower and O&M. And the eventual total impact upon the big three spenders, which includes acquisition costs, will be inadequate to enable maintenance of the military posture which America will need for the price Americans will be willing to pay.

I believe this dichotomy can be resolved but it will take some radical revisions of Military Service concepts.

Manpower, O&M and acquisition are the

1-2-3 spenders. Yet our Military Services operate, in the broad context, essentially as they did before World War II when threats and responses were quite different, and when civilian interest and involvement were low. I'm not talking about strategy and tactics and weapons which *have* changed, but rather about the organic capability concepts which are so expensive to acquire and sustain and which, in many cases, are no longer required.

These concepts require a self-contained capability to operate and maintain a weapon system at all levels regardless of the basing and deployment plan—a complete and almost entirely separate logistics support system is acquired and sustained which duplicates the functions of the industrial team producing the weapon system. For example, an intercontinental ballistic missile system based in the United States obviously is not going to be redeployed. Really substantial savings could be made by never buying a "military specification" support system, by using contractor personnel for many of the operations and most of the maintenance functions, and by gross reduction of the subsidized infrastructure that doesn't show up in the accounting system in a fashion where it can be discreetly challenged.

The same is true for large portions of transport aircraft functions. In fact, if DOD is going to be able to operate effectively with future budgets, it will be necessary to make very serious studies of elimination of entire commands rather than the peanut butter reduction approach that can destroy everyone's effectiveness, while only saving a small percentage of dollars. An innovative concept could be worked with the airlines which would satisfy air transport functions efficiently at less than the present cost, assuming equitable accounting treatment, proper designation of training expenses, and elimination of passengers and cargo which are carried because "we are going anyway."

Changes Needed

If defense spending is going to provide a quality product, *national security*, for a price that is competitive with national social and economic needs, the defense establishment is going to have to go through the process many of our corporations have been going through. It must develop an accounting system that enables cost trades, examine the institutional hierarchies versus the necessity of their functions or the cost of reduced or increased activity, work the "make or buy" in the Government on a real cost basis, drive management authority to the lowest possible levels, develop a performance measurement system for these managers that includes meaningful and understandable cost performance parameters and, by all means, continue the very productive efforts to improve cost management techniques in defense systems development.

These are very difficult political and institutional problems to deal with. It will take an enormous amount of courage but it may mean our survival. I believe Americans will support a strong America. We should, however, earn such support by vigorous effort to produce this strength within funding constraints which enable America to be as strong economically and socially as militarily. I believe we can achieve this balance. □

Genius is one percent inspiration and ninety-nine percent perspiration.

—Thomas Alva Edison

Answer to Cost Growth

Many Questions Surround Design to a Cost Concept

Developing, designing and building a product to a predetermined cost is not a new concept. As a matter of fact, American industry owes a great deal of its strength and capability to this long time practice. When, for example, a manufacturer of commercial communication equipment sees a potential place in the market for a new product to fulfill a particular need, he investigates and, at the very outset, determines that price at which the new product would, in his opinion, generate the most favorable (and most profitable) reception. His subsequent deliberations then include trade-off decisions with respect to various factors other than price such as:

- What, if any, competitive products are already in the market?
- What performance capabilities would be most desirable in the new product, with a definite scale of priority assigned to each?
- What patentable innovations, if any, could be utilized in the design of the new product?

These factors and many more facets of the problem are studied and analyzed but always with the ultimate objective of introducing the new commercial product at the predetermined price.

Although design to a cost is, therefore, not new, its possible application to defense procurement is a refreshingly new approach. How current procurement policies and practices will be adapted to the concept on a practical basis remains to be determined. At the present moment, there are, disturbingly enough, many in the DOD procurement circle who believe that design to a cost has always been in the procurement picture and that, ergo, the present regulations and policies need no revision or adaptation for its implementation. On the other hand, it is industry's hope that with the present extensive changing of top DOD personnel the primary purpose behind the new approach won't be lost in the general reorientation of policies, directives and regulations that we believe must take place.

by A. A. Landesco
Chairman, Government Procurement Relations Council
Electronic Industries Association

Opinions expressed herein are those of the author and not necessarily those of the Department of Defense.

Varied Interpretations

One of the strangest things about design

to a cost is that people both within and without the Department of Defense seem to have a varying understanding of its fundamental objective. Unfortunately, many see a very close similarity to the total package procurement approach that was tried unsuccessfully several years ago and now ostensibly has been barred from further use. Others consider design to a cost as another new idea that, if ignored long enough, will go away by itself. But some of us think of it as a very plausible answer to the present major problem of sharply reducing cost growth in major weapon systems procurement.

Several months ago in a discussion, Allan Simon, former Assistant Director (Air Warfare) in the Office of the Director of Defense Research and Engineering, explained very succinctly the main thought behind design to a cost. He indicated that design to a cost procurement envisions the "maintenance of options" from the cradle to the grave in the life of a major weapon system. The options, of course, are with respect to choices of action to be taken to ensure the system's complete life cycle through creation, manufacture and use is achieved at a predetermined cost to the Government. Options would include, but not be limited to, such things as:

- Relaxation or modification of specifications (design and/or performance) to permit continuation of any phase of the project at the predetermined cost.
- Change of contractors if such an action will permit continuation of the project at any stage, still at the original cost.
- As an undesirable but perhaps necessary trade-off, one option could well be turning off the project completely, accompanied by a decision to use an alternative product already in existence.

Unanswered Questions

The problem of incorporating the design to a cost approach in day-to-day defense procurement with minimum modification of present ground rules brings up a myriad of unanswered questions.

The unfortunate thing is that too many people having insufficient background to understand fully the basic objectives of the design to a cost concept think they already know the answers to many of these questions. There are, however, many unanswered potential problems. Preconceived notions as to the best (?) way to answer these questions may lead to the abortion or complete destruction of this refreshingly new approach to reduction of project cost growth. Unless design to a cost is reasonably and properly applied, it can very well lead to another series of "horror stories" equivalent to those caused by the over-implementation of the total package procurement concept. On the other hand, uncontrolled use of design to a cost without full appreciation of the possible results of its misapplication can lead to failure in achieving the primary objective of adherence to a predetermined cost.

Some of the questions resulting from brief discussion among a handful of industry oriented people are:

- At what stage in the weapon systems procurement process can design to a cost be most advantageously applied from everybody's point of view?
- How much can and should the contractor contribute toward the maintenance of options during his performance of a particular phase of a design to a cost project?
- How can both Government and industry personnel be effectively motivated to take full advantage of the design to a cost concept?
- In the case of the Government, how can sufficient latitude be injected into current procurement regulations and defense contracts to permit relaxation or modification of specifications as may be necessary and desirable to ensure completion of performance at the original cost?
- In the case of industry management, how can it be motivated to propose realistic rather than optimistic technical objectives when proposing to a predetermined price?
- How do we approach the warranty problem with its accompanying unpredictable cost elements?
- Similarly, what trade-offs are desired and are desirable with respect to unpredictable maintenance-in-the-field costs and the trade-off possibilities between them and greater product dependability in the first place?
- How can design to a cost best be passed down through tiers of subcontractors?

• How can design to a cost be practically applied without further inflaming and increasing industry's overhead costs in the performance of defense contracts?

Industry is well aware that Defense Department personnel have equally complex questions of their own that must be answered; and after we resolve the fundamental questions, how many hundreds less fundamental but equally frustrating questions are left for resolution? It is our hope that everyone will strive to make design to a cost a practical, effective and mutually advantageous *permanent* factor in future defense procurement. We don't want it aborted nor do we want it to pass into oblivion. We do want it explored thoroughly with the fond hope that it will become the answer to our most urgent defense problem today. How do we maintain our position as the strongest force in the world for the maintenance of lasting peace at a cost that can be successfully borne by our economy? □

EIA To Conduct Seminar on Design to a Cost Concept

A seminar will be conducted by the Electronic Industries Association's (EIA) Government Procurement Relations Council, April 25–26, 1973, at the Sheraton Park Hotel, Washington, D.C. Its purpose will be to help alleviate problems that might be encountered by defense contractors working under the current design to a cost concept being promulgated by top DOD officials.

According to the EIA council chairman, A. A. Landesco of RCA Corporation, the seminar will feature panel discussions on contracts and incentives; warranties and reliability and field maintenance, for both contractors and DOD; prime supplier pass-down; cost credibility; reduction of overhead costs of doing business with DOD; and organization and implementation of continuing trade-off possibilities.

Additional information concerning the seminar may be obtained from C. James Reeves, Staff Director of the Government Procurement Relations Council at EIA headquarters in Washington.

a few words about...

$169 Million Savings Achieved

A DOD official whose direction in internal reporting resulted in an annual savings of $169 million received one of the Federal Paperwork Management Awards presented in 1972. The award, given annually to Government and industry officials responsible for exceptional paperwork management achievements, was presented to Richard D. Brown, Director for Information Control, OASD (Comptroller), for his outstanding leadership and contributions in improving information management practices throughout the Federal Government.

Under his direction DOD achieved an annual savings of $169 million in internal reporting and 720,000 man-hours in reports required from the public. This achievement exceeded the goal set for DOD and represented 84 percent of the overall Government-wide savings goals established by the President, resulting in a total savings far exceeding initial goals.

Mr. Brown actively participated on the interagency task force studying the adequacy of the organization, functions and resources for managing reporting systems and reports in the Federal departments and agencies.

Stolen Fuel Detector

Army will use color coding to combat the problem of pilfered petroleum, oil and other lubricants.

A new procedure, developed at the Army Land Warfare Laboratory, consists of adding a colorless additive to the fuel and subsequently using an identification agent system kit.

This development assists Army in determining where the stolen fuel is and from where it was stolen.

One gallon of the additive, which does not affect fuel performance, is sufficient for marking 20,000 gallons of fuel products. It may be placed in fuel storage tanks prior to or during filling.

This new "Button" type strip, fastened to the radome of an aircraft, will dissipate multiple lightning strikes without affecting electrical performance of the radome.

Army Commands Cited for VE Accomplishments

Four major Army organizations received Army Commendation Awards for outstanding achievement during FY 1972 in reducing costs through Value Engineering (VE) actions. The organizations receiving the awards and their achievements were:

- *Army Safeguard System Office* which received 41 contractor-initiated VE change proposals and originated 86 in-house VE proposals that resulted in a Government savings of $46 million (over 460 percent of its goal).
- *Army Corps of Engineers* which received 261 contractor-initiated VE change proposals and originated 129 in-house VE proposals that resulted in Government savings of $19 million (over 194 percent of its goal).
- *Army Materiel Command* which received 600 contractor-initiated VE change proposals and originated 1,365 in-house VE proposals that resulted in Government savings of $102 million (over 173 percent of its goal).
- *Army Security Agency* which received 6 contractor-initiated VE change proposals and originated 19 in-house VE proposals that resulted in Government savings of $4.7 million (over 472 percent of its goal).

The Comptroller of the Army has overall responsibility for the Army Value Engineering Program.

Cost Savings

While it may look like scrap, materials removed from the inside of test cells and wind tunnels when test programs are changed at Arnold Engineering Development Center represent a considerable dollar savings in the Center's operation. As part of the RECON (Resources Conservation) program, this scrap is regularly screened to remove all reusable components and resulted in savings close to $200,000 during FY 1972.

Security Program

Development and procurement of static and mobile security systems for all DOD facilities has been assigned to Air Force Systems Command's Electronic Systems Division (ESD).

Formerly known as the Air Base Defense Program Office, the new organization has been designated as Base and Installation Security System (BISS) in ESD's Deputate for Tactical Systems.

In its tri-Service role, BISS has been tasked with enhancing security at DOD installations in any geographical location and operational environment.

BISS will include families of sensors, monitor and display devices, communication devices, access control subsystems, alarm verification subsystems and automated response subsystems.

BISS personnel are also working jointly with the Department of Justice, Bureau of Customs and the Border Patrol to develop special purpose security devices.

Steering Committee Will Monitor DOD Productivity Efforts

A Defense Productivity Steering Committee has been established within the Office of the Secretary of Defense chaired by Vice Admiral Eli T. Reich, Deputy Assistant Secretary of Defense (Production Engineering and Materiel Acquisition). Its function will be to assure uniformity in all guidance developed and issued to the Military Departments and Defense Agencies for use in their productivity programs.

Other members of the Steering Committee are Eckhard Bennewitz, OASD (I&L); George Sutherland, ODDR&E; George Bergquist and John Questch, OASD (Comptroller); and George Daoust, OASD (M&RA).

The importance of measuring and enhancing productivity in the Federal sector has been emphasized by a joint productivity project sponsored by the Office of Management and Budget, the Civil Service Commission and the General Accounting Office. DOD participated in this joint effort along with 16 other Government agencies.

TT Indicators Being Tested To Aid Control of Items with Limited Shelf Life

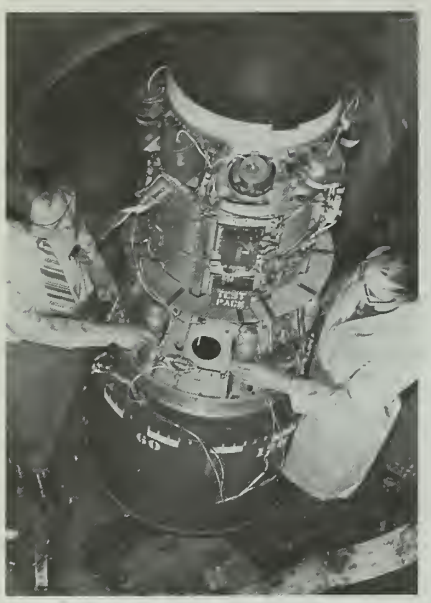
An experiment being conducted at Defense Depot Tracy, Calif., by the Army Natick Laboratories will involve carefully observing changes in specially designed times and temperature (TT) indicators. These indicators may become a standard aid in controlling the issue of commodities with limited shelf life.

The transparent plastic TT pouches contain a fabric material with a written message about the shelf life of the item in storage along with a dark red liquid which turns clear when exposed to air.

When the liquid clears, the written message on the fabric material becomes readable. It may indicate what disposition is to be made of the stock, what steps are to be taken, or other pertinent information.

The speed with which the liquid clears is temperature related. The higher the temperature, the faster the liquid loses its red color.

The experiment at the Tracy Defense Supply Agency Depot will be observed for some time, probably as long as two to three years, before any final determination is made on the feasibility of widespread use of TT indicators as an aid to controlling storage of items with a limited shelf life.



Modified adapter section joining the second and third stages of the Athena H research launch vehicle is prepared for test in a high altitude cell at the Air Force Systems Command's Arnold Engineering Development Center. The solid-propellant rocket is used to test reentry systems and hardware by the command's Space and Missile Systems Organization (SAMSO).

Symposium Scheduled on Vessel Traffic Systems

The U.S. Coast Guard has scheduled a symposium on Vessel Traffic Systems at the Shoreham Hotel, Washington, D.C., on May 15, 1973. Its purpose is to familiarize industry with the progress of existing systems and present plans for new installations in the United States.

Vessel Traffic Systems are being established to coordinate vessel movements in ports, harbors and other congested waters. Purpose of these systems is to reduce the probability of ship collisions and groundings, and damage to the surrounding environment. The symposium will cover equipment requirements, vessel movement monitoring systems, aids to navigation and communications concepts.

Further information on the symposium may be obtained from the National Security Industrial Association headquarters in Washington, D.C.

X-24B Test Flights

Shaped to fly as both a spacecraft and a wingless airplane, the X–24B experimental lifting body was recently delivered to the Air Force and the National Aeronautics and Space Administration.

The X–24B will be a joint Air Force-NASA flight research program at AFSC's Air Force Flight Test Center (AFFTC) and the NASA Flight Research Center, both at Edwards AFB, Calif.

About 30 flights are planned, starting in 1973 and extending into 1975.

Goal of the flights is the testing of a wingless craft's handling qualities for an extended near-earth flight and for conventional runway approach and landing.

The shape, modified from that of the earlier X–24A, is further patterned for flights from earth to extreme altitudes and speeds five times that of sound. The main change is a new aluminum alloy outer structure, which is delta shaped; it doubles the craft's lifting surface.

In this test program the craft will not be flown faster than about mach 1.5 to obtain performance data primarily from 900 miles an hour down to landing speed.

New Technique Cuts Size and Cost of MCRL

Users of the Master Cross Reference List (MCRL), a list of item Federal Stock Numbers cross-referenced to manufacturers' part numbers, will no longer have to cope with dozens of bulky volumes. Distribution of the MCRL is now being made in an envelope containing 4- by 6-inch sheets of microfiche. Each microfiche sheet, on which all Federal Catalog publications will eventually be produced, contains up to 270 images (pages). Each page is viewed separately on a mechanical viewer which enlarges it to readable size.

According to the Defense Supply Agency, a number of firsts are associated with the conversion of the MCRL from printed volumes to microfiche:

- The MCRL is the first publication to be converted to fiche format by the Defense Supply Agency's Defense Logistic Support Center, which is responsible for Federal Catalog microform production, management and distribution.

- The MCRL is the first publication in microfiche to be sold to the general public by the Government Printing Office.

- The conversion is the first major use of microfiche technology in Government printing. Microfiche replaces an electronic composing system technology which was revolutionary when it appeared five years ago and was then first used to print the MCRL volumes.

Overall, publishing the MCRL in microfiche is expected to cost about one-half of the not-so-very old way.

Letters to the Editor

Dear Sir:

In re-reading the April 1972 issue I came upon an article which I either missed or initially read too hurriedly. I refer to "Management—Creating the Environment" by Major T. Schwartz, USAF. I take exception . . . to his statement that in the government we cannot afford the luxury of striving to achieve long-range goals, but must instead, because of political necessity, strive for the short range objectives. . . . I heartily believe in the primacy of long-range goals, particularly in relation to our Federal Government and its defense goals. . . . One of the characteristics of quality management is the ability to "see the big picture", both breadth and depth, and plan in such manner that those goals will be achieved, those goals being the goals of the greater organization rather than the goals of any individual manager's organization.

Further on in his article he says ". . . it is paramount that management actively concern itself with their people resource", to which I would respond "that's what management is". Management consists of accomplishing objectives through the use of other participants. Managers are not do-ers, but rather facilitators who make it possible for those who work for them to accomplish their functions, the only job of the manager is to interact with people, he does not deal with things, only the workers do that.

I do wholeheartedly agree with the author that the managers job is to create an environment, an environment which will elicit their (the workers) participation in accomplishing the organizational goals. I would go further, though, to add that he accomplishes this through both physical and conceptual acts; the physical act is that of communication and the conceptual act is that of decision making. The communicating and decision making is an integral part of performing the functions of management, i.e., the planning, organizing, directing and controlling.

Very truly yours,

Wm. R. Johnston
Dayton, Ohio

Dear Sir:

. . . Mr. Johnston . . . tends to state the obvious. Patriotism or loyalty do not enter into a discussion of this nature. One should always strive to do his best in any endeavor. The primacy of long range planning and seeing the big picture do not necessarily mean that decisions made or courses of action pursued will support such planning. Suboptimization is in evidence throughout public life where public officials are elected to office.

I did not state, as Mr. Johnston implies, that long range plans are not made. If anything, the military excels in long range planning. I did state that short range goals (successes) are sought after rather than long range goals. The rationale for this statement being that the electoral process requires a need to demonstrate achievement within the term of incumbancy.

Sincerely,

Major Thomas Schwartz,
USAF

Presidential Management Improvement Awards 1972

Colonel A. L. Schalbrack, USA, accepts from President Richard M. Nixon, on behalf of the Defense Depot, Ogden, Utah, a 1972 Presidential Management Improvement Award. Secretary of Defense Elliot L. Richardson observes the presentation. The Depot was cited for dynamic and progressive management improvement achievements in its pioneering of base supply mechanization, automated shipping processes and improvement of inventory record accuracy. Col. Schalbrack is the Depot Commander.

Captain William D. Harkins, USN, receives from President Richard M. Nixon a 1972 Presidential Management Improvement Award for his dynamic leadership in moving the North Island Naval Air Rework Facility to a position of prominence as a naval industrial plant. Secretary of Defense Elliot L. Richardson observes the presentation. Capt. Harkins is the former Commanding Officer of the Facility and is now assigned as Director, Depot Management Division, Logistics/ Fleet Support Group, Naval Air Systems Command.

Department of Defense Recipients of Presidential Management Improvement Certificates

Department of the Army

Major Leonard J. Rodowick
CW2 Michael L. Klinkbeil
Geronimo Escobar
George V. Johnson
LTC Joseph N. Laseau
Colonel Jack W. Nielsen
Major Albert J. Rivard
Charles R. McBride
LTC Donald M. Vosel
Charles F. Lipsey
Glenn D. Rierson
Wayne A. Smith
M. I. Hinson
Morris C. Croker
Jacob Gelberman
Robert L. McGraw Sr.
John F. Miles Jr.
Maj. Gen. William L. Starnes
Fred C. Brothers
George F. Erie
Thomas A. Evans
Directorate for Maintenance Operations, Hq USARBCO
Commercial Communications Branch, USASTRATCOM

Department of the Navy

Rear Admiral Samuel L. Gravely Jr.
LT Harry L. Turner II
James A. Angelo
Albertus Mather
CPO Terry G. Burke
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Bobbie J. Hardee
Wallace E. Dietrich
Leo J. Brogan
Captain Richard C. O'Loughlin
CPO David Rodman
Evelyn E. Schumacher
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Office of Manpower Utilization, USMC

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Lawrence J. Bauer
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Air Force Satellite Control Facility
Aeronautical Systems Division
Air Defense Weapons Center

Defense Supply Agency

Maurice D. Levine
Myron J. Files, Jr.
Betty L. Henderson

defense management JOURNAL

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